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PETERBOROUGH DEMONSTRATION
PROJECT:
COLLECTION OF PLASTIC FILM
IN THE BLUE BOX

FINAL REPORT

AUGUST 1991



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PETERBOROUGH DEMONSTRATION PROJECT:

COLLECTION OF PLASTIC FILM
IN THE BLUE BOX

FINAL REPORT

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FORWARD AND ACKNOWLEDGMENTS

FORWARD

Developing the Demonstration Project

In 1989, the Recycling Sub-Committee of the Environment and Plastics Institute of Canada (EPIC) established a demonstration framework to investigate the curbside collection of plastic film.

In February of 1990, the EPIC Recycling Sub-Committee approached Proctor & Redfern Limited (Consulting Engineers, Architects, Scientists and Planners) to assist in the development of the demonstration program and to carry out demonstration activities. The Ontario Ministry of the Environment (MOE) was approached by EPIC to co-sponsor the Plastic Film Demonstration Project.

The main objective of the demonstration project was to collect detailed information on the feasibility of adding plastic film to the list of recyclable materials collected at the curb in an established blue box program. EPIC and MOE determined that detailed information was required in the following general areas:

- quantity of plastic film that could be collected,
- collection techniques,
- participation rates,
- capture rates,
- an assessment of the material quality,
- logistics of sorting the plastic film from other recyclable materials,
- ability to market the recovered plastic film including an understanding of the logistics of baling the material, shipping, and processing into feedstock for use in a marketable product.

The data collected in a demonstration project will be used to assist other municipalities in determining the requirements to add plastic film to their mix of recyclable materials.

Project Steering Committee

The following people formed the Project Steering Committee and were responsible for the establishment and design of the demonstration project in Peterborough, data collection during the 28 week demonstration period, report writing and review:

Mike Hyde	EPIC Recycling Sub-Committee
Dave Climenhage	EPIC Recycling Sub-Committee
Dave Birkby	EPIC Recycling Sub-Committee (Chairman)
Fred Edgecombe	EPIC (Executive Director)
Rick Warner	MOE
Jane Lister	MOE
Ivan Bateman	City of Peterborough
Jay Stanford	Proctor & Redfern Limited
Patty Quackenbush	Proctor & Redfern Limited
Peter Gwyn	Proctor & Redfern Limited

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We wish to acknowledge the cooperation and assistance of our host community, the City of Peterborough. In addition, we wish to acknowledge the work and effort of several government agencies, organizations and private firms in providing valuable information and comments throughout this study. We are grateful to the following people listed below that have made themselves available throughout the project or for specific assignments:

EPIC: Fred Edgecombe, Bob Hamp and the members of the EPIC Recycling Sub-Committee

MOE: Rick Warner, Jane Lister, Brendan Killackey

Du Pont Canada Inc.: David Climenhage, Dick Oughten, Rob Kearns

Dow Chemical Canada Inc.: Mike Hyde, Bruno Gaeckel

Plax Inc.: David Birkby

Novacor Chemicals Ltd.: Nolan Edmunds, Mike Koyich

Resource Plastics Inc.: Barry Woods

Tetra Pak Inc.: Abe Kabayama

City of Peterborough: Ivan Bateman

Scott's Plains Recycling Inc.: Bill Thomas, Ray Hallock and the recycling staff

Ottanabee Valley and King George Public Schools: staff and students

DISCLAIMER

The statements, opinions, summaries and conclusions expressed in this Demonstration Project report are those of the Project Steering Committee, comprised of Proctor & Redfern Limited (Consulting Engineers, Architects, Scientists and Planners) and selected individuals from the Environment & Plastics Institute of Canada (EPIC), Ontario Ministry of the Environment (MOE) and the City of Peterborough. The statements and opinions do not necessarily represent those of the full membership of EPIC or the Ministry of the Environment.

Mention of products, technologies, and private firms in this study should not be construed as an actual or implied endorsement or recommendations for use.

EXECUTIVE SUMMARY

Purpose of this Report

The purpose of this report is to provide a description of the methodology undertaken and results obtained from a demonstration project to collect plastic film in the blue box. The findings presented in this report will be of interest to municipalities currently involved in or investigating curbside source separation programs for recyclable materials, private sector companies engaged in the collection, sorting, and processing of plastic film into a marketable feedstock, private sector firms that are capable of using post consumer polyethylene pellets as feedstock in their manufacturing process and public interest groups.

Study Objective

The objective of the demonstration project was to determine the feasibility of collecting plastic films in an Ontario blue box program.

Background Information

Plastic film has only recently become a target blue box material. It has been collected by numerous blue box programs in Ontario because it is seen as an appropriate method of placing newspapers at the curb. To date, very little has been done regarding collection of plastic film.

Plastic film discarded by households represents approximately 45% (by weight) of the plastic packaging waste stream and approximately 1.5% (by weight) of the residential waste stream. The largest portion of plastic film discarded is low density polyethylene (LDPE) such as grocery sacks, milk pouches and outer bags, bread bags and produce bags. In addition, high density polyethylene (HDPE), polypropylene (PP), polyvinyl chloride (PVC) and polyvinylidene chloride (PVDC) also are used in packaging applications that are discarded. These materials represent a relatively uncontaminated stream of pure resins that can be recycled with existing technology, if it is first feasible to collect them in a blue box collection program.

Study Area Description

The City of Peterborough was chosen to host the Plastic Film Demonstration Project because of its well-established and successful blue box program. The City's blue box collection program currently serves single family households and includes newspaper, steel cans, aluminum cans, glass containers and PET 2 litre soft drink bottles.

The study area consists of two separate collection routes, Test Area A with 1,578 households and Test Area B with 1,372 households. The two collection routes were chosen in consultation with Peterborough officials for the following reasons:

- both routes were representative of the City's mix of income groups, mainly middle income with small numbers of high and low income housing types, and
- both routes were serviced by the same driver and vehicle, with Test Area A collection on Wednesday and Test Area B collection on Friday.

The sorting and baling of the plastic film was conducted at the Scott's Plains Recycling Facility.

Public Education and Promotion

Three weeks prior to commencement of the 28 week collection period, householder information kits were hand delivered to each of the households in the test areas. Throughout the demonstration project, three project updates were hand-delivered to the households in the test areas. Each was designed to provide information on the progress of the demonstration project, as well as to instruct the householders about any changes in the demonstration project at various stages.

A telephone survey was conducted during the last few weeks of the demonstration project. The objectives of the telephone survey were as follows:

- to evaluate the effectiveness of the public relations program including the information kits and project updates,

- to determine the residents' perceptions and attitudes towards the pilot project and blue box collection in general,
- to determine the success of the project from the public viewpoint, and
- to identify any problems or areas requiring further study.

Questionnaire results indicate that the public information program was informative and useful overall. However, differences were noted between Type I and Type II participants*. More than 97% of Type I participants in both test areas found the information informative and useful, although this percentage dropped substantially for Type II participants in both areas. Only a small percentage of the respondents in both test areas and in both participation types would have liked additional project information. This response was not consistent with the previous response for Type II participants.

The fridge magnet which identified the requested plastic films in either test area was a popular component of the information kit as over 80% of the Type I participants in both test areas were still using it at the end of the demonstration project. Almost all of the Type II participants were found to have discarded their fridge magnets.

Strong conclusions can not be drawn as to why different responses were found between the two participant groups. However, consistent responses were found between the same participant types.

Results of Demonstration Project Activities

Description and Assessment of Material Collected

The list of acceptable film types differed for the two test areas. Test Area A included all household plastic films. Test Area B was restricted to polyethylene films, LDPE and HDPE such as grocery sacks and shopping bags.

*(Note: a Type I Participant is defined as a household with extra or additional plastic film in their blue box. A Type II Participant is defined as a household with plastic film in their blue box only used as packaging for the newspaper, such as a grocery sack. These classifications were derived during the four week participation analysis study.)

Test Area A:

- LDPE; e.g., grocery sacks, milk pouches,
- HDPE; e.g., some shopping bags,
- laminates; e.g., chip bags, candy bags,
- PP)/PVC/PVDC; e.g. food stretch wraps, and
- other films (not easily identified).

Test Area B:

- LDPE, and
- HDPE.

Quantity

The average weekly quantities of plastic film recovered (including contamination) in each of the test areas were:

- Test Area A - 48.0 grams/Hh/week (2.50 kg/Hh/year)
- Test Area B - 42.5 grams/Hh/week (2.21 kg/Hh/year)

The average weekly quantities recovered of requested plastic film materials (as requested in the project information kit) were:

- Test Area A - 45.3 grams/Hh/week (2.36 kg/Hh/year)
- Test Area B - 40.6 grams/Hh/week (2.11 kg/Hh/year)

Composition

Comparison of quantities of plastic film types collected per household per week in each test area indicate that there is little difference in the quantities collected of LDPE and HDPE between the two test areas:

- Test Area A - 40.9 grams LDPE/Hh/week (2.13 kg/Hh/year)
- 2.2 grams HDPE/Hh/week (0.11 kg/Hh/year)

- Test Area B - 39.1 grams LDPE/Hh/week (2.03 kg/Hh/year)
 - 1.5 grams HDPE/Hh/week (0.08 kg/Hh/week)

In Test Area A, the sum of laminates, PP/PVC/PVDC and other film categories made up less than 5% of the total weight collected (5.2% of the acceptable plastic film material). In Test Area B, where these plastic film types were not requested, the sum of other plastic films made up 2% of the total weight collected.

Participation Analysis

The purpose of the participation analysis was to determine the percentage of households that placed plastic film in their blue box relative to the total number of households served by the blue box program in the test areas. A "participating household" is defined as a household that sets out a blue box containing flexible plastic film at a minimum frequency of once every four weeks.

A classification of all test area households with respect to blue box recycling and the demonstration project is shown on Figures 1 and 2. The classifications outlined are as follows:

- Blue Box participant - a household that places a blue box at the curb at least once in four weeks,
- Demonstration Project participant - a household that places a blue box with plastic film at the curb at least once in four weeks,
- Type I participant - a demonstration project participant identified as placing additional plastic film in their blue box, and
- Type II participant - a demonstration project participant identified as placing only plastic bags with ONP in their blue box.

Results indicate that of those households already participating in the blue box program (78% in Test Area A and 76% in Test Area B), over 90% placed plastic film in their box during the demonstration project, and of these, 64% to 77% took the extra effort to separate additional plastic film from their waste stream at the minimum frequency level or better. In summary, the following program participation was determined for those households participating in the blue box program in each test area:

Figure 1**Summary of Participation Study
Study Area "A"**

PARTICIPATION IN BLUE BOX PROGRAM (four week period only)	No. of Homes	Percent of Study Area
Did Not Participate	346	21.9%
Set Out Blue Box Once In 4 Weeks	324	20.5%
Set Out Blue Box Twice In 4 Weeks	311	19.7%
Set Out Blue Box Three Times In 4 Weeks	303	19.2%
Set Out Blue Box Four Times in 4 Weeks	294	18.6%
TOTAL BLUE BOX PARTICIPATION DURING 4 WEEKS	1232	78.1%
TOTAL HOUSEHOLDS	1578	100.0%
PILOT PROGRAM	No. of Homes	Percent of Study Area
Did Not Include Film	449	28.5%
Included Film Once in 4 Weeks	367	23.3%
Included Film Twice in 4 Weeks	305	19.3%
Included Film Three Times in 4 Weeks	256	16.2%
Included Film Four Times in 4 Weeks	201	12.7%
INCLUDED FILM AT LEAST ONCE IN 4 WEEKS	1129	71.5%
TOTAL HOUSEHOLDS	1578	100.0%

Figure 2

**Summary of Participation Study
Study Area "B"**

PARTICIPATION IN BLUE BOX PROGRAM (four week period only)	No. of Homes	Percent of Study Area
Did Not Participate	325	23.7%
Set Out Blue Box Once in 4 Weeks	259	18.9%
Set Out Blue Box Twice in 4 Weeks	300	21.9%
Set Out Blue Box Three Times in 4 Weeks	241	17.6%
Set Out Blue Box Four Times in 4 Weeks	247	18.0%
TOTAL BLUE BOX PARTICIPATION DURING 4 WEEKS	1047	76.3%
TOTAL HOUSEHOLDS	1372	100.0%
PILOT PROGRAM	No. of Homes	Percent of Study Area
Did Not Include Film	395	28.8%
Included Film Once in 4 Weeks	287	20.9%
Included Film Twice in 4 Weeks	299	21.8%
Included Film Three Times in 4 Weeks	227	16.5%
Included Film Four Times in 4 Weeks	164	12.0%
INCLUDED FILM AT LEAST ONCE IN 4 WEEKS	977	71.2%
TOTAL HOUSEHOLDS	1372	100.0%

	A	B
■ Blue box participation	100.0%	100.0%
■ Demonstration project participation	91.5%	93.3%
■ Type I participation	58.0%	71.8%

When all households that have access to blue box collection are included in the analysis, all participation rates are lowered as follows:

	A	B
■ Total test area households	100.0%	100.0%
■ Blue box participation	78.1%	76.3%
■ Demonstration project participation	71.5%	71.2%
■ Type I participation	45.8%	54.8%

Capture Rate Analysis

The purpose of the capture rate analysis ('snapshot') was to determine the quantities of plastic film resin types that are collected in the blue box of a participating household in relation to the quantities generated in that household.

Results indicate that the capture rate for LDPE and HDPE type films are higher than for laminates, PP/PVC/PVDC, and other films. Separate results are shown for the two participation classifications:

Test Area A: Type I Participants - 48.5%
Type II Participants - 3.8%

Test Area B: Type I Participants - 46.4%
Type II Participants - 4.8%

The results of the calculation of quantity captured and capture rates for Types I and II participants in Test Areas A and B are presented as follows:

Test Area A:

Type I participant	quantity captured	=	4.873 kg/Hh/year
	capture rate	=	4.873/14.0
		=	34.8%

Test Area B:

Type I participant	quantity captured	=	3.717 kg/Hh/year
	capture rate	=	3.717/8.4
		=	44.3%

As was observed during the demonstration project, reuse rates (e.g. grocery sack used as a waste basket liner) ranged from 10% to 20% across the test areas and participation types. Therefore, the combined capture and reuse rates for Type I participating households are:

- Test Area A: 35% capture + 10% to 20% reuse = 45% to 55%, and
- Test Area B: 44% capture + 10% to 20% reuse = 54% to 64%.

Material Quality Analysis

The purpose of analyzing material quality was to determine the levels of non-requested materials and contamination in the collected plastic film. Non-requested materials are those materials excluded from the collection program as outlined in the initial information kit. The quantity of non-requested materials present in the collected plastic film are indicative of the amount of sorting required at the MRF.

The average percentage of 'non-requested' materials in Test Area A was 5.6% by weight while in Test Area B it was 4.5% by weight. 'Other materials' made up a larger percentage of material collected in Test Area A than B (4.7% in A compared to 2.2% in B). This difference could be attributed to the greater number of materials and plastic film types allowed in Test Area A. This may have caused the householder to practice less discretion about the materials placed into the Blue

Box. Test Area B plastic films consisted primarily of grocery sacks and shopping bags, which are easily identified and generally require less effort to clean and source separate. (Note: it is not possible to estimate the percentage of non-requested materials that were directly the result of the addition of plastic film because non-requested materials were arriving in the ONP compartment prior to the demonstration project.)

The total residue contamination remaining in the material collected in both test areas is approximately 0.6%, which is not significant in terms of processing requirements.

Conveyor Belt Sorting Analysis

The householders were instructed to 'stuff' the plastic film into the same bag alongside the newspaper or in a separate plastic bag. The driver of the collection vehicle placed the plastic film into the same compartment as the newspaper and therefore no sorting at curbside was required. A plastic bag containing other plastic films would require only one additional toss onto the collection vehicle. Observations of collection early in the demonstration project and discussions with the driver responsible for the test area collection routes indicated that there was not a measurable increase in time to collect the test area plastic film at the curb. Since the newspaper compressed the film in the ONP compartment, no problems were encountered with the compartment filling up or "cubing out".

Therefore, the incremental time required to collect and sort film is accounted for primarily at the MRF following delivery of the materials. This time was measured through the conveyor belt sorting analysis.

The purpose of the conveyor belt sorting analysis was to determine the incremental increase in time required to sort the test area plastic film from the newspaper compared to the base case. The base case is defined as the time to sort the existing plastic film arriving in loads of newspaper from non-test areas.

On average for this study, it was found that there was an approximate increase of 85% in the time required to sort one kilogram of ONP in the base material to the time to sort one kilogram of ONP in the test area material. However, it should be

realized that for each kilogram of ONP sorted there was 6.5 times more plastic film sorted in the test area material than the base case material.

Calculations are presented which express the results in terms of staff hours required to sort one tonne of test area material as well as the incremental time to sort one tonne of plastic film. The municipality may apply local value for labour efficiency and employee wages to these staff hour/tonne estimates to calculate an average cost relative to one tonne of ONP.

A sample calculation has been done by applying estimated costs to a city of equivalent size to Peterborough (assuming: 80% labour efficiency; \$10 per staff hour). The results indicate that the annual incremental cost attributed to the city would be an estimated \$12,000. Application of this cost to all city households results in a cost of \$0.57 per household per year (or an incremental cost of \$245/tonne for incremental tonne of plastic film).

Marketing Plastic Film

A total of three bales were prepared from plastic film collected during the demonstration project:

- Bale #1 contained only pre-sorted LDPE and HDPE collected over a 12 week period from Test Area A,
- Bale #2 contained all plastic films, except contaminants, collected during a 12 week period from Test Area B households, and
- Bale #3 contained all material, except contaminants, collected during a 9 week period from Test Area A households.

All bales were placed on a regular transport trailer using a forklift. No special requirements were needed at the MRF, on the vehicle or at the plastic processing centre. The three bales were shipped to Resource Plastics Corporation in Brantford, Ontario. Bales #1 and #2 have been processed. To date, about half of Bale #3 has been processed. The remaining portion of Bale #3 will be processed after some modifications are made to the facility. The material from the demonstration project passed through the following basic process steps: shredding, washing, separating, drying and pelletizing.

All processed LDPE pellets from Bales #1 and #2 were placed into large storage containers, labeled, and shipped to research laboratories at Du Pont Canada Inc. and Novacor Chemicals Ltd. for analysis. Half of Bale #3 is currently being analyzed at Dow Chemical Canada Inc.

The first two bales were successfully processed into LDPE pellets. Only minor problems were encountered during the recycling process (e.g. pellet cracking due to gases associated with the inks, etc.). Further difficulties were encountered when processing Bale #3. Independent investigations are currently under way to isolate the problem areas and determine probable causes. For further information regarding the pellet analysis results, the reader is asked to send a written request to EPIC. A technical report summarizing this information will be available from EPIC at a later date.

Converting LDPE Film Pellets into Marketable End Products

One of the most significant findings of the demonstration project has been the demonstration that mixed plastic (polyethylene) film collected from curbside in Test Area B can be processed back to film quality pellets in the process used by Resource Plastics (Note: based on the composition of plastic films collected in Peterborough, the pellets that were processed at Resource Plastics are referred to as LDPE pellets).

Plastic films under 1 mil (0.001 inches) thickness were manufactured with 50% recycled content. Also demonstrated was the manufacture of 1.5 to 2 mil films with 100% recycled content. This result should be qualified by the fact that the runs were relatively short and this will not necessarily represent the level of recycled content that can be achieved on all plastic extrusion lines. However, it is clear that a significant level of LDPE can be added to a number of existing polyethylene films. As a result, the recycled resin will have access to a very large existing market and can replace virgin resin sales in a number of end uses. This should provide more than adequate markets for the blue box plastic films collected in Ontario and other provinces in Canada as programs are established.

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1.0 PURPOSE OF THIS REPORT

The purpose of this report is to provide a description of the methodology undertaken and results obtained from a demonstration project to collect plastic film in the blue box. The findings presented in this report will be of interest to the following groups:

- municipalities in Canada currently involved in curbside source separation programs for recyclable materials that are considering adding additional materials,
- municipalities in Canada that are investigating the requirements to establish a curbside source separation program,
- private sector companies engaged in (or considering) the collection, sorting and processing of plastic film into a marketable product,
- private sector firms that are capable of using post consumer low density polyethylene pellets as feedstock in their manufacturing process, and
- public interest groups and citizens that are interested in obtaining detailed information on the requirements and characteristics of adding or establishing plastic film as a recyclable and marketable material in curbside source separation programs.

Detailed information on all aspects of the demonstration project is provided in the following areas:

Chapter 2.0 Background Information

Chapter 3.0 Description and Establishment of Demonstration Project

Chapter 4.0 Public Education and Promotion

Chapter 5.0 Results of Demonstration Project Activities

Chapter 6.0 Conclusions and Summary of Findings

2.0 BACKGROUND INFORMATION

2.1 Overview of Curbside Collection of Recyclable Materials in Canada

The basic concept of recycling is to recover materials of value from the waste stream and to use them as feedstock for industry instead of landfilling or incineration. There are many potential benefits to recycling. As less material enters the landfill, municipal waste disposal costs may be reduced or, more importantly, existing landfill space is conserved. In addition to the conservation of energy and natural resources, the revenue that is generated from the sale of recovered materials helps to offset the cost of recycling.

Potentially marketable materials must be identified and separated from the waste stream and must be in a form acceptable to the market. In general, efforts to separate materials are required to:

- meet quality specifications,
- be consistent in quality, and
- be reliable and predictable in quantity.

The more reliable the supply is, the greater the potential price is. However, even at zero revenue, a benefit may still result in reducing disposal requirements.

Material for recycling (recyclables) may come from either residential (single family households, multi-family households) or commercial/industrial sources. Municipalities have more direct control over the waste generated by residential sources, usually providing collection as a service in urban areas and in some rural areas. These wastes can be more readily managed at the source and some savings in regular waste collection costs may be achieved by collecting recyclables separately.

Since the mid-1980s there has been a tremendous increase in the number of multi-material source separation programs being used as an important component of a modern waste management system. Starting with the first "Blue Box" program initiated in the City of Kitchener in 1981, numerous programs have been implemented across Ontario. Other provinces in Canada including British

Columbia, Alberta, Manitoba, Quebec, New Brunswick and Nova Scotia have also implemented recycling programs.

In multi-material curbside source separation collection programs, householders separate out recyclable materials from their waste and set them out at the curb for pick-up. The most commonly specified recyclable materials (often referred as traditional materials) included in the blue box collection are:

- newspapers,
- glass containers,
- ferrous and aluminum cans, and
- polyethylene terephthalate (PET) 2 litre soft drink bottles.

Some jurisdictions in Canada have experimented with curbside collection of other recyclables (often referred to as expanded materials) including:

- high density polyethylene (HDPE) (e.g., plastic milk bottles, fruit juice containers),
- other mixed rigid plastics (e.g., all bottles and containers),
- all plastics (e.g., bags, bottles, containers),
- old corrugated containers (OCC),
- magazines, and
- paperboard containers (e.g. shoe boxes, cereal boxes, etc.)

Materials from blue box collections are usually collected in separate multi-compartment vehicles or in the multi-compartment trailers towed by regular collection vehicles. The latter is commonly used in rural areas where there is more operating room for turning. The materials are partly or fully sorted by category when loaded. The extent of sorting at the curb depends upon the number of compartments, the number of categories collected and the degree of sorting already performed at the materials recovery facility (MRF).

Quantities collected by blue box programs vary depending upon a number of factors:

- extent and effectiveness of public education and promotion,
- cultural/economic/social profile of the community,
- average size and weight of major newspapers in circulation,
- season, holiday periods and weather,
- whether the program is voluntary or mandatory.

The most successful blue box programs in Ontario have demonstrated material recycling rates for traditional blue box materials of between 10% and 15% of the waste normally collected by the municipality. Traditional blue box materials usually represent between 18% and 23% (by weight) of all residential waste.

Material recycling rates refer to the amount of waste diverted from landfills or incinerators by recycling initiatives. Material recovery rates for any material are determined by a combination of the participation rate (fraction of people in the community using their blue box) and the capture rate (fraction of blue box materials actually put out by participants). Recovery rates for blue box materials are typically between 40% and 60% of what is theoretically possible. In some communities, material recovery rates may approach 80% for some materials such as newspapers.

2.2 Curbside Collection of Residential Plastics in Ontario

The Society of the Plastic Industry of Canada began investigating the curbside collection of plastic containers in 1985 when five areas in Canada were selected for a two-phased study:

- City of Kitchener, Ontario,
- City of Niagara Falls, Ontario,
- Regional Municipality of Halton, Ontario,
- Regional Municipality of Durham, Ontario, and
- Quebec City, Quebec.

Although the quantities collected in the Phase 1 communities were quite small during the eight-week measuring period, it did identify the need for further, more detailed investigations. As a result, the City of Niagara Falls became the location for Phase 2 work. Two test areas were established:

- PET only collection from 500 households, and
- all rigid plastic containers (including plastic tubs) from 400 households.

Information from Phase 2 collected over a nine-week period was much superior to that of Phase 1 with the following reasons cited for the change:

- better promotion to the householder, and
- expansion of plastic products to include all plastic containers.

The curbside collection of plastic packaging in Ontario began shortly after 1987 when Twinpak Inc., manufacturer of the PET 2 litre soft drink bottle, became a member of the Ontario Multi-Materials Recycling Inc. (OMMRI was established in 1986 by Ontario's soft drink industry to foster and fund curbside recycling operations in the province). The PET bottle soon became a common recyclable material collected at the curb across Ontario.

The inclusion of PET in the blue box brought about a number of requests from different levels of government and the private sector for information on adding other rigid plastic containers to the mix of recyclable materials. In 1988, a comprehensive demonstration project was undertaken to determine the feasibility of collecting mixed rigid plastic containers through a blue box program (see next subsection).

The collection of plastic film as a target material (i.e. the householder is specifically asked to place it into the blue box) began in the City of Mississauga as part of a pilot program in 1989. Plastic film was included among the plastic packaging items in Mississauga which included rigid plastic containers, plastic toys, plastic crates, etc. this program has since been expanded city-wide (see Subsection 5.7.5 for additional programs).

Although plastic film has only recently become a target material, it has been collected by numerous blue box programs in Ontario because it is seen as an appropriate method of placing newspapers at the curb. Many municipalities request that the householder place the newspaper loosely into a plastic bag and sit it next to the blue box on collection day. This allows more room in the blue box for container materials. Also the newspaper tends to stay drier and is quicker to load into the

collection compartment compared to loose newspaper. Newspaper bundled with string or plastic twine is also a common approach. However, at the materials recovery facility (MRF), the newspaper often has to be opened to remove contamination (i.e. unwanted materials). This requires additional time plus the sorter is required to have access to scissors or a knife. Newspaper in an open plastic bag can be quickly emptied by the sorter to check for contamination

2.3 The Barrhaven Demonstration Project

The Environment and Plastics Institute of Canada identified the need to investigate and document the requirements to collect mixed rigid plastic containers from households through a curbside source separation program. In December 1988, EPIC and the MOE sponsored a demonstration collection project in Barrhaven, a community located within the City of Nepean (part of the Regional Municipality of Ottawa-Carleton), Ontario, to:

- determine the available quantity of all types of rigid plastic containers in the residential waste stream,
- determine if volume reduction is necessary, and
- assess the incremental effect on the sort/collection time of paper, glass and metal with the addition of plastics.

The project was conducted on four collection routes comprised of approximately 5,800 homes over a 24-week period. Rigid plastic containers were added to the current group of blue box materials consisting of newspapers, glass containers, and steel and aluminum containers.

Rigid plastic containers collected averaged 3.2 kg/household/year overall for Barrhaven, or 7.7 kg per year per participating household. Participation, defined as setting out plastic containers at least once in 4 weeks, averaged 51% over the 24 week period. The collected rigid plastics consisted of: 75% polypropylene/polyethylene (PP/PE), 12% PET, and 13% other (polystyrene/polyvinyl chloride - PS/PVC).

Two collection trucks were used to collect rigid plastic containers loose, one vehicle was fitted with a hydraulically-driven perforator/flattener and the other with a

hydraulically-driven granulator. However, in the final analysis, the volume and quantity of plastics collected did not warrant the use of densification equipment on the collection vehicles.

The results of the study indicated that it was feasible in Barrhaven to collect mixed rigid plastic containers in the blue box without significant modifications to the existing collection system. The report did indicate that conclusive data could not be obtained during the demonstration study to ensure that modifications to existing collection systems would not be required in the future. Current blue box collection experience suggests that collection vehicles fill up quicker when collecting mixed rigid plastic containers and that the overall weight of the vehicle is lower based on the same number of blue box set-outs.

Since the Barrhaven Demonstration Project, many blue box collection programs in Ontario have added a number of rigid plastic containers to the current list of materials collected at the curb. Additional information on the Barrhaven Demonstration Project is presented in Appendix C. Information on specific programs collecting rigid plastic containers in the blue box can be obtained from EPIC and OMMRI.

2.4 Rationale for a Plastic Film Demonstration Project

To date, very little has been done regarding curbside collection of plastic film. Data cannot be obtained from existing curbside collection programs in Ontario collecting plastic film for two reasons:

- the current Ontario blue box programs that collect plastic film include it among a list of plastic packaging items. For example, a plastic bag may contain a juice jug, a dishwashing detergent bottle and other plastic bags. All materials are placed into a single compartment on the collection vehicle and delivered to the MRF to be baled, and
- sorting does not take place at the MRF because all plastic packaging is marketed as 'mixed plastics' to Superwood Ontario Ltd., the predominant end market for mixed plastics in Ontario. At the Superwood facility, the mixed plastics are extruded without any resin separation.

Plastic film discarded by the household represents approximately 45% (by weight) of plastic packaging waste stream and approximately 1.5% (by weight) of the residential waste stream (see subsection 5.2). The largest portion of plastic film discarded is low density polyethylene (LDPE) such as grocery sacks, milk pouches and outer bags, bread bags, and produce bags. In addition, HDPE, PP, PVC and polyvinylidene chloride (PVDC) are also used in packaging applications that are discarded. These materials represent a relatively uncontaminated stream of pure resins that can be recycled with existing technology, if it is first feasible to collect them in a blue box collection program. Plastic films can be recycled into a wide range of film products such as garbage bags, industrial bags and painter drop sheets.

In 1989, the Recycling Committee of EPIC began to investigate the requirements to operate a demonstration program comparable to the one in Barrhaven and established a demonstration framework which included a number of issues that required investigation (Subsection 3.1). In February of 1990, the EPIC Recycling Committee approached Proctor & Redfern Limited (Consulting Engineers, Architects, Scientists and Planners) to assist in the development of the demonstration program and to carry out demonstration activities. The MOE was approached by EPIC to sponsor a plastics demonstration project.

The main purpose of operating a demonstration project was to collect detailed information from an established blue box program on the feasibility of adding plastic film to the list of recyclable materials collected at the curb. EPIC and MOE determined that detailed information was required in the following general areas:

- quantity and quality of plastic film that could be collected,
- collection techniques,
- participation and capture rates,
- logistics of sorting the plastic film from other recyclable materials, and
- ability to market the recovered plastic film including understanding the logistics of baling the material, through shipping and processing into feedstock for use in a marketable product.

The data collected from a demonstration project can be used to assist other municipalities in determining how to add plastic film to their mix of recyclable

materials and how to account for the associated costs of sorting plastic film in their overall program cost.

2.5 Discussion of the Role of Plastic Films

Plastic films play a number of important roles in the home and in other consumer purchasing activities such as transportation, product protection, dissemination of product information, product differentiation and advertising (plastic films play many vital roles in the workplace as well). The use of many types of plastic films complements source reduction strategies due to the lightweight nature of the material and its ability to incorporate post-consumer plastic film. In addition, various types of plastic films can be reused before being recycled (e.g. plastic bag containing lunches) or replace the need to purchase some bag products such as garbage container liners.

Each role may change with the type of plastic film, whether it is a carry-out bag or protective covering. Some examples are:

- transportation - plastic films produced into grocery bags and carry-out bags for consumers that are lightweight but strong and easy to carry. These bags offer great reuse potential. Also, the lightweight nature adds very little weight to the product, therefore the purchaser buys far less packaging per product,
- product protection - plastic films in the form of bags and 'outer bags' are used to contain and protect many products such as frozen food and milk; some plastic films are clear allowing the consumer to view a product without having to touch it,
- dissemination of product information - printed directly onto plastic films such as safety and health notices, product descriptions and instructions or perhaps to convey important community information, and
- product differentiation and advertising - the product manufacturer can use the natural attributes of the product as part of the advertising campaign because the product can be viewed by the consumer.

3.0 DESCRIPTION AND ESTABLISHMENT OF DEMONSTRATION PROJECT

3.1 Study Objectives

The objective of the demonstration project was to determine the feasibility of collecting plastic films in the Ontario blue box program. To determine the feasibility, a list of issues and questions were identified that required detailed investigation during the course of the demonstration project. Among the list of issues and questions were the following:

Source separation

- What quantity of non-requested materials may arrive with the plastic film and will the householder clean materials before placing them in the blue box?
- Will the householder provide the quality of material that can be sorted at a materials recovery facility (MRF) to meet end market processing specifications (free of paper and other contaminants)?
- Are there differences in the quantity and quality of plastic films collected if different lists of requested materials are provided to the residents of different collection areas?
- Was the public relations program effective?
- What is the participation rate?
- What quantity of plastic film will be recovered per household?, per participating household?

Collection

- What, if any, additional volume is required on the collection vehicles?
- Will there be any incremental collection time?
- Are additional collection vehicles required?
- Does addition of plastic film cause vehicle cube-out?
- Is on-truck densification necessary?
- Was there any difference at curbside between the collection areas?
- What is the most practical collection strategy?

Sorting

- What is the resin composition collected by weight?
- Will there be any incremental sorting time?
- Can existing MRFs in Ontario be used to sort this material?

Processing and Marketing

- Will the MRF provide the quality of material necessary to meet end market processing specifications?
- Can the collected plastic films be processed into marketable pellets?
- Is this material suitable for co-mingled plastic manufacture (e.g. plastic lumber)?

3.2 The Study Area

The City of Peterborough was chosen to host the Plastic Film Demonstration Project because of its well-established and successful blue box program. In addition, Peterborough had been selected previously by marketing firms to test a number of new products and for other types of initiatives because its socio-economic make-up is considered representative of Ontario.

The City of Peterborough uses 3 side-loading vehicles to cover 15 different curbside collection routes per week. Vehicles are on collection routes 5 days per week providing weekly collection to all areas in Peterborough. The total population of the city is approximately 65,000 including approximately 20,230 single family households and 7,155 multi-family dwellings (apartment units). The blue box collection program currently includes newspaper, steel cans, aluminum cans, glass containers, and PET 2 litre soft drink bottles.

Two separate collection routes were selected to be in the Study Area; Test Area A with 1,578 households and Test Area B with 1,372 households. The two collection routes were chosen in consultation with Peterborough officials for the following reasons:

- both routes were considered representative of the City in terms of socio-economic status. Each route had a small percentage of low income and high income groups with the majority being classified as middle income. Also, both routes were determined to have similar attributes (e.g. several new subdivisions, etc.). A detailed soci-economic profile of the two collection routes was determined not to be necessary, and
- the same driver and vehicle was responsible for both routes which would maintain consistency in collection throughout the demonstration project.

Test Area A has collection on Wednesday and Test Area B has collection on Friday. Two lists of acceptable (requested) plastic films were prepared and distributed to households in each collection route. Test Area A had a longer list of acceptable plastic films than Test Area B (see Sections 4.1 and 5.2 for further details). Because the Test Areas are not physically separated from the rest of Peterborough, communication to the public was accomplished by using direct household delivery to avoid confusion with those households not within the Study Area, and between the two test areas.

The sorting and baling of the plastic film was conducted at the Scott's Plains Recycling Facility. It is operated by Scott's Plains Recycling Inc., a non-profit organization. The 1,400 square metre MRF contains the following processing equipment: newspaper and fine paper sorting conveyor, glass/PET sorting conveyor, conveyor and magnetic separator for cans, old corrugated cardboard sorting area and a baler.

3.3 Program Establishment and Preparation

The preparation for the demonstration project was undertaken in the twelve weeks prior to the commencement of the 28-week collection period. It involved the following activities:

- collecting background data and meetings with the City and Scott's Plains Recycling Inc. including:
 - route selection and details, and

- operational and other logistics,
- hiring a project assistant to work at the MRF:
 - a graduate of the environmental studies program at Trent University was hired to work for the duration of the project; responsibilities included daily monitoring of collection activities, sorting materials into resin types, acting as a liaison between Proctor & Redfern project staff and Scott's Plains personnel, distribution of public relations material, responding to 'hotline' telephone inquiries, and assisting in a number of the pilot studies,
- confirming lists of materials to be collected from the test areas,
- preparing detailed work programs for each individual pilot 'mini' study including scheduling of all activities. The issues and questions identified in Section 3.1 formed the basis for preparing the detailed investigations to be carried out during the 28-week collection period,
- meetings with representatives of Du Pont Canada Inc. and Dow Chemical Canada Inc. to discuss appropriate film resin categories for sorting and quick identification techniques. The following plastic film categories were established for the study:
 - low density polyethylene (LDPE) - this category includes grocery sacks, milk pouches, outer bags. LDPE is very easy to identify,
 - high density polyethylene (HDPE) - this category includes some shopping bags and small film pouches. A simple 'crinkle test' can be quickly used to differentiate between LDPE and HDPE,
 - laminates - this category includes all multi-layered plastic films such as chip bags, candy bags, frozen food bags. (Note: it was evident after the training sessions that this category would pose some difficulties because some multi-layered plastic films are from the same resin family, whereas others could be a mixture of resins. In addition there are a variety of laminate applications.),

- polyvinyl chloride (PVC)/polyvinylidene chloride (PVDC)/ polypropylene (PP) - this category includes food stretch wraps, cigarette wrappers, medicine seals, etc. As a general rule, all clear plastic films that when folded created a crease in the material were placed into this category. (Note: some difficulties also existed in this category. Firstly, although technically PP does not belong in this category, the amount of PP used as a plastic film is quite small. Secondly, the best approach to differentiate between PP and PVC is through a flame or acid test. This was not appropriate for use in the demonstration project.),
 - other films - this category includes miscellaneous plastic films which are not easily identified. They may have arrived in small pieces without any markings that would help in the identification process. It was agreed in the beginning that this category would be monitored to ensure all reasonable efforts at identifying the appropriate category were undertaken,
- preparing a resin identification board showing samples of plastic film types for sorters and conducting training programs for the driver and sorters,
 - preparing and implementing all public education and promotion activities including a householder information kit, information sessions, and media releases.

4.0 PUBLIC EDUCATION AND PROMOTION

4.1 Activities Prior to Demonstration Project

Householder Information Kit

Three weeks prior to commencement of the 28 week collection period, householder information kits were hand delivered to each of the households in the test areas. The kits included the following information:

- letter from the Mayor,
- project overview,
- list of acceptable films ("A" and "B"),
- a few words about recycling plastics,
- invitation to the Information Session, and
- fridge magnet.

Copies of the information kit are included in Appendix D.

Information Sessions

Included in the information kit was an invitation to a Demonstration Project Information Session. One was held in each test area, May 8, 1990 at Otonabee Valley Public School (Test Area A) and May 10, 1990 at King George Public School (Test Area B). The sessions were held to provide additional information about the demonstration project and to answer any questions. A draw for a free backyard composter was held at each session, providing an additional incentive to attend. Approximately 25 to 30 householders attended each session. Feedback from those who attended indicated that the information provided in the Information Kit was sufficient and straight forward.

Other Activities

The Peterborough media, including the Peterborough Examiner, radio stations CHEX and CKPT, were invited to attend the information sessions and were sent copies of the Householder Information Kit. The resulting articles are included in

Appendix E. A telephone hotline was provided in Peterborough and Toronto to answer inquiries about the program. A few calls were received at the outset of the program, however, it was not frequently used after that point.

4.2 Activities During Demonstration Project

Throughout the demonstration project, three project updates were hand-delivered to the households in the test areas. Each was designed to provide information on the progress of the demonstration project, as well as to instruct the householders about any changes in the demonstration project at various stages:

Project Update #1 - delivered early July, 1990. The main purpose was:

- to respond to questions and comments received at the Demonstration Project Information Sessions that would be of interest to all test area residents, and
- to announce winners of the backyard composters,

Project Update #2 - delivered last week of August to first week of September, 1990. The main purpose was:

- to remind test area residents of the pilot project after the interruption of summer holidays and update them regarding progress to date and upcoming "mini-studies". An incentive (free dinner for two) was provided to encourage the householders to read the information provided in the update.

Project Update #3 - last week of November, 1990. The main purpose was:

- to notify test area residents of the completion of the demonstration project and the City's plans to continue collection of plastic film in the test areas.

Copies of the Project Updates are provided in Appendix E.

4.3 Activities After Demonstration Project

A telephone survey was conducted during the last few weeks of the demonstration project. The objectives of the telephone survey were as follows:

- to evaluate the effectiveness of the public relations program including the information kits and project updates,
- to determine the residents' perceptions and attitudes towards the pilot project and blue box collection in general,
- to determine the success of the project from the public viewpoint, and
- to identify any problems or areas which would require further study.

Only households previously determined to be blue box participants were contacted. One hundred questionnaires were completed in each test area. The respondents were classified into the following participation types:

Test Area A:	Type I participant (extra film)	63%
	Type II participant (bagged ONP)	34%
	Non-participant (no film)	3%
Test Area B:	Type I participant (extra film)	70%
	Type II participant (bagged ONP)	24%
	Non-participant (no film)	6%

(Note: A Type I Participant was defined as a household with extra or additional plastic film in their blue box. A Type II Participant was defined as a household with plastic film in their blue box only used as packaging for the newspaper, such as a grocery sack).

A separate list of questions was developed for each participation type. Copies of the three questionnaires plus the responses are found in Appendix F.

Questionnaire results indicate that the public information program was found to be informative and useful (Table 4.1). However, differences were noted between Type I and Type II participants. More than 97% of Type I participants in both test areas found the information informative and useful, but this percentage dropped substantially for Type II participants in both areas. Only a small percentage of the

respondents in both test areas and participation types would have liked additional project information. This response was not consistent with the previous response for Type II participants.

The fridge magnet was a popular component of the information kit. Over 80% of the Type I participants in both test areas were still using it at the end of the demonstration project. Almost all of the Type II participants were found to have discarded their fridge magnets.

Strong conclusions can not be drawn as to why different responses were found between the two participant groups. However, consistent responses were found between the same participant types.

Other responses by participant type are as follows:

Type I: Extra Plastic Bags and Film

- more than 95% in both test areas felt that it is necessary to receive blue box recycling information on a regular basis,
- more than 97% in both test areas stated that they received enough demonstration project information during the six months,
- between 65% and 71% indicated that they did not require any more time to clean/prepare plastic film for their blue box compared to other recyclable materials,
- less than 10% indicated that they placed their blue box at the curb more frequently when plastic films were added,
- more than 80% in both test areas stated that they reused plastic bags to line waste baskets, and
- all respondents indicated that they would like to continue placing plastic bags and films into their blue boxes

Type II: Bagged Newspaper - (No Extra Plastic Bags and Film)

- all respondents in both test areas felt that it is not necessary to receive blue box recycling information on a regular basis,
- only 8% of the respondents in Test Area B stated that they would have liked to have received more demonstration project information during the six months,
- the main reasons cited (more than one was allowed) for not placing additional plastic bags and film in their blue box were:

	A	B
- inconvenient or time consuming	32%	29%
- do not throw out plastic bags and film	24%	21%
- was not aware of the pilot project	32%	54%
- did not understand the purpose of the pilot project	6%	4%
- information provided not clear	0%	8%
- other	24%	29%,

- more than 83% in both test areas stated that they reused plastic bags to line waste baskets.

5.0 RESULTS OF DEMONSTRATION PROJECT ACTIVITIES

5.1 Introduction

Collection of the plastic film in the two test areas, including 1,578 households in Test Area A and 1,372 households in Test Area B, began May 23, 1991 and continued for 28 weeks to November 29, 1990. During this period a number of pilot studies were conducted to investigate all aspects of the demonstration project from household separation to processing and marketing the recovered material. These studies are described in detail in the following sections:

- Description and Assessment of Material Collected,
- Participation Analysis,
- Capture Rate Analysis,
- Material Quality Analysis,
- Conveyor Belt Sorting Analysis,
- Marketing Plastic Film, and
- Film Recovery from Schools.

Householders were requested to place plastic film in the same bag as their newspapers or into a separate bag and then into their blue box. The blue box was to be placed at the curb as usual by the householder. The plastic film was loaded into the newspaper compartment of the recycling vehicle.

5.2 Description and Assessment of Material Collected

All plastic films collected during the 28 week collection period were weighed each week and sorted into categories by the Project Assistant. The data from the initial two weeks of plastic film collection were not included to avoid distortion of the amounts generated and to remove the effects of householders saving large quantities of plastic film in anticipation of the pilot start-up.

During the study period there were variations and fluctuations in the weekly quantities due to events such as breakdown of collection vehicles on the test area routes, a drivers' strike and maintenance activities at Scott's Plains. Typically, a disruption in collection during one week caused an increase in quantities collected

the following week. These events were recorded and where no data were available, estimates were included to account for these disruptions. In addition, the collection period was extended two weeks to obtain further data.

The list of acceptable plastic film types differed for the two test areas. Test Area A included all household plastic films. Test Area B was restricted to polyethylene films, low density and high density polyethylene, such as grocery sacks and shopping bags. Further examples of these resin types are found in Appendix C. They can be summarized as follows:

Test Area A:

- low density polyethylene (LDPE); e.g., grocery sacks, milk pouches,
- high density polyethylene (HDPE); e.g., some shopping bags,
- laminates; e.g., chip bags, candy bags,
- polypropylene (PP)/polyvinyl chloride (PVC)/, polyvinylidene chloride (PVDC); e.g. food stretch wraps, and
- other films (not easily identified).

Test Area B:

- low density polyethylene (LDPE), and
- high density polyethylene (HDPE).

5.2.1 Quantity

The average quantity collected per test area household per week is illustrated on Figures 5.1 and 5.2. Note that this is indicative of the quantity recovered (i.e., total weekly quantity divided across the total number of test area households regardless of whether they are participating or not).

The average weekly quantities of plastic film recovered (including non-requested materials and contamination) in each of the test areas were:

Figure 5.1
Test Area A: Average Quantity Collected per Test Area Household

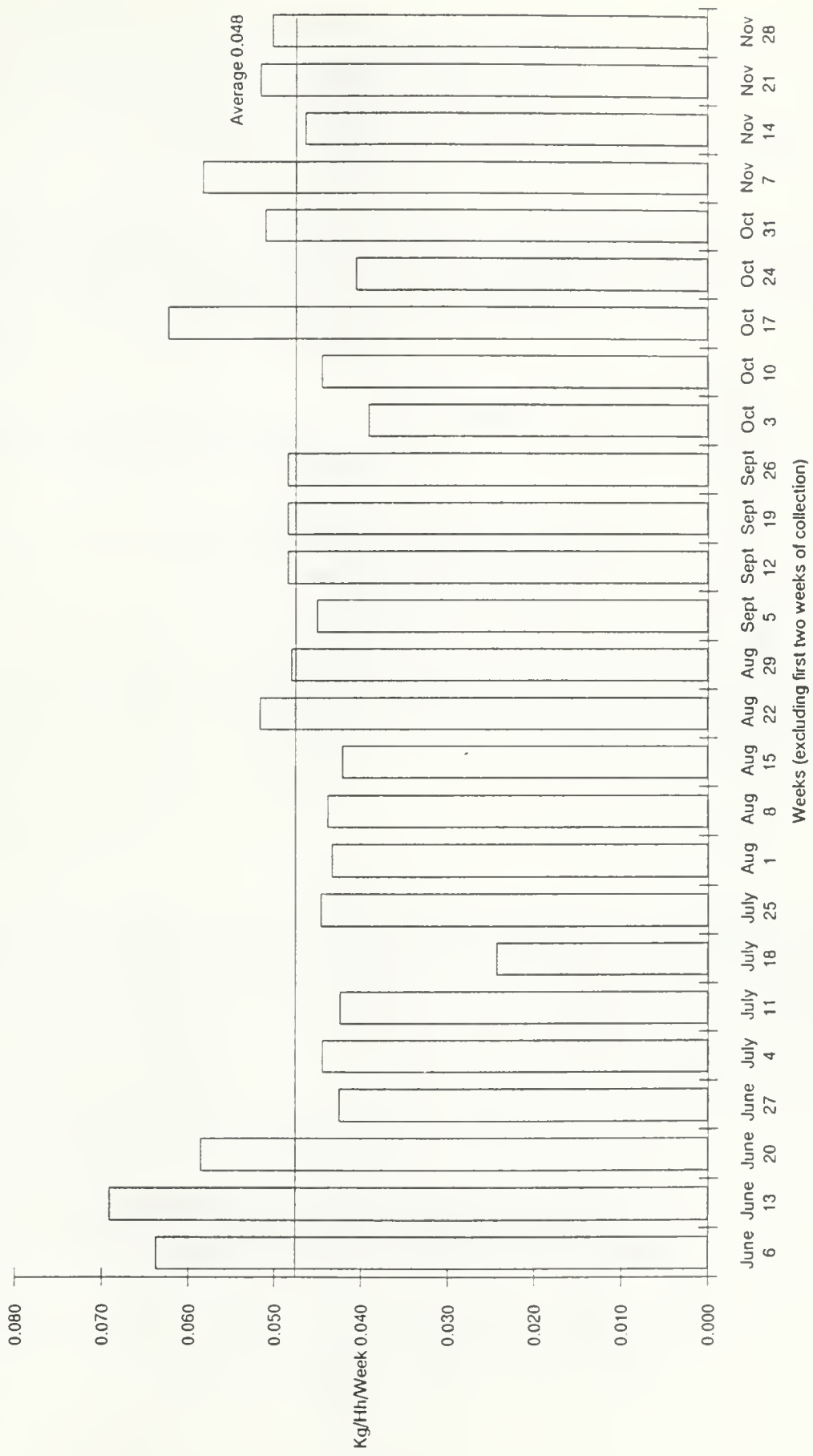
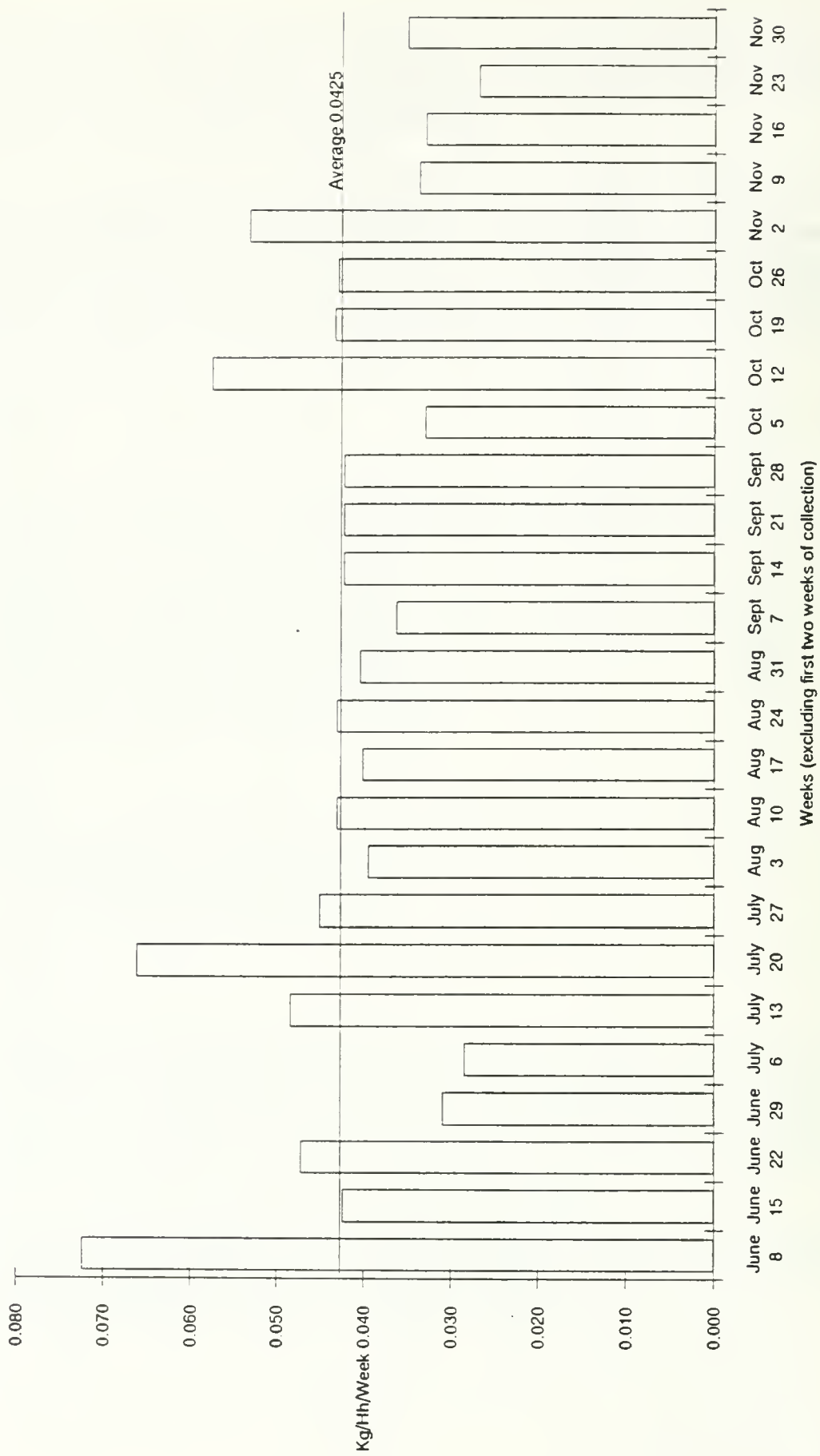


Figure 5.2
Test Area B: Average Quantity Collected per Test Area Household



- Test Area A - 48.0 grams/Hh/week (2.50 kg/Hh/year)
- sample standard deviation = 9.1 (sample size = 26 weeks), and
- Test Area B - 42.5 grams/Hh/week (2.21 kg/Hh/year)
- sample standard deviation = 10.6 (sample size = 26 weeks)

The coefficient of variation, which is the ratio of the sample standard deviation to the sample average, provides an indication of the variance of the sample with respect to the mean, was found to be 19.0% and 24.9% for Test Areas A and B, respectively.

The average weekly quantities recovered of requested plastic film materials (as requested in the project information kit) were:

- Test Area A - 45.3 grams/Hh/week (2.36 kg/Hh/year), and
- Test Area B - 40.6 grams/Hh/week (2.11 kg/Hh/year).

Appendix G contains a discussion of statistics including a linear regression of the total quantities collected each week and hypothesis testing of the mean quantities collected in each test area. No significant trends in the quantity of plastic films recovered at the curb were identified.

5.2.2 Composition

The category composition (either a single resin or groups of resin types) of the requested plastic films are shown in Figures 5.3 and 5.4 for Test Areas A and B. Non-requested materials and contaminants that were collected are not illustrated on these figures. Comparison of quantities of plastic film types collected per household per week in each test area indicate that there is little difference in the quantities collected of LDPE and HDPE between the test areas:

- Test Area A - 40.9 grams LDPE/Hh/week (2.13 kg/Hh/year)
- 2.2 grams HDPE/Hh/week (0.11 kg/Hh/year)
- Test Area B - 39.1 grams LDPE/Hh/week (2.03 kg/Hh/year)
- 1.5 grams HDPE/Hh/week (0.08 kg/Hh/week)

Figure 5.3

Test Area A: Average Composition of Plastic Film by Category

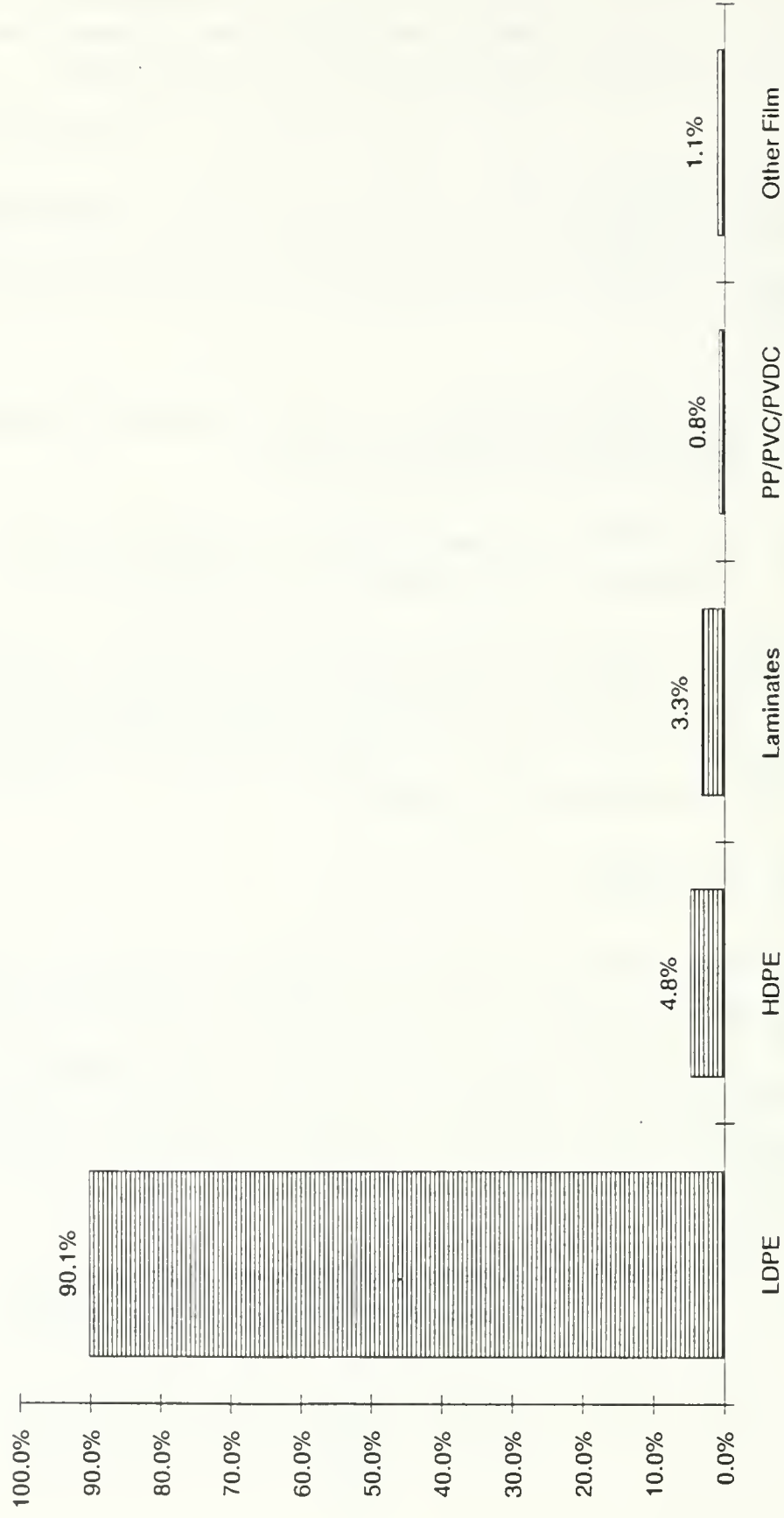


Figure 5.4

Test Area B: Average Composition of Plastic Film by Category



As expected, the dominant material collected during the demonstration project was LDPE. This is the largest single polymer type in household use. The predominance of LDPE in film uses is unique to Ontario. The ratio of LDPE to HDPE as a plastic film material (predominantly in grocery sacks and carry-out bags) varies between provinces and in the United States. In some jurisdictions, the ratio approaches 50:50 which may cause problems when the polymers are processed together. LDPE is the polymer of choice in Ontario to manufacture plastic bags and pouches for a wide variety of uses from grocery sacks and milk pouches to frozen food and produce bags. This situation will enhance the potential of recovering plastic bags and films in Ontario because the mix will be predominantly LDPE.

In Test Area A, the sum of laminates, PP/PVC/PVDC and other film categories made up less than 5% of the total weight collected (5.2% of the acceptable plastic film material). In Test Area B, where these plastic film types were not requested, the sum of other plastic films made up 2% of the total weight collected.

Three bales of mixed rigid and film plastic from Mississauga (one bale of 510 kg) and Markham (2 bales, 310 kg) were sorted at Superwood Ontario Limited to determine the relative mass of these materials when collected by curbside collection programs and the composition of the plastic films. The plastic film was sorted into the categories outlined in Test Area A. The 'snap shot' composition of the plastic film for both Markham and Mississauga support the results found in the demonstration project.

5.3 Participation Analysis

Purpose

The purpose of the participation analysis was to determine the percentage of households that placed plastic film in their blue box relative to the total number of households served by the blue box program in the test areas. A "participating household" is defined as a household that sets out a blue box containing plastic film at a minimum frequency of once every four weeks.

The households placing plastic film in their blue box were further classified as Type I or Type II participants:

- Type I participant - a household that placed extra plastic bags and film (extra film) in their blue box (in addition to the packaging of old newspaper ONP), and
- Type II participant - a household that only placed plastic film in the form of a plastic bag as packaging for ONP in the blue box.

Methodology

The participation analysis was conducted during the four-week period from September 12 to October 5, 1990. Prior to its commencement, a Project Update was distributed to serve as a reminder of the demonstration project after the disruption of summer holidays. A database containing the addresses of all of the residences in the test areas was established to allow for on-going data input and monitoring during the study. A project staff member accompanied the blue box vehicle driver on the test area routes during the four week period, recording the following for each household: presence of a blue box at the curb, and presence of plastic film.

In addition, for a subset of houses (approximately 300) in each test area, households were classified as Type I and Type II participants.

Participation was calculated for each test area as follows:

$$\text{participation rate} = \frac{\text{no. of Hh with plastic film at curb at least once in four weeks}}{\text{total no. of Hh in test area}} \times 100\%$$

Results

Participation rates found in each test area indicating the number of homes with varying set-out rates are found on Tables 5.1 and 5.2. The households defined as participating in the pilot program had plastic film in their blue box as extra film or packaging for ONP. A classification of all test area households with respect to blue box recycling and the demonstration project is shown on Figures 5.5 and 5.6. The classifications outlined are as follows:

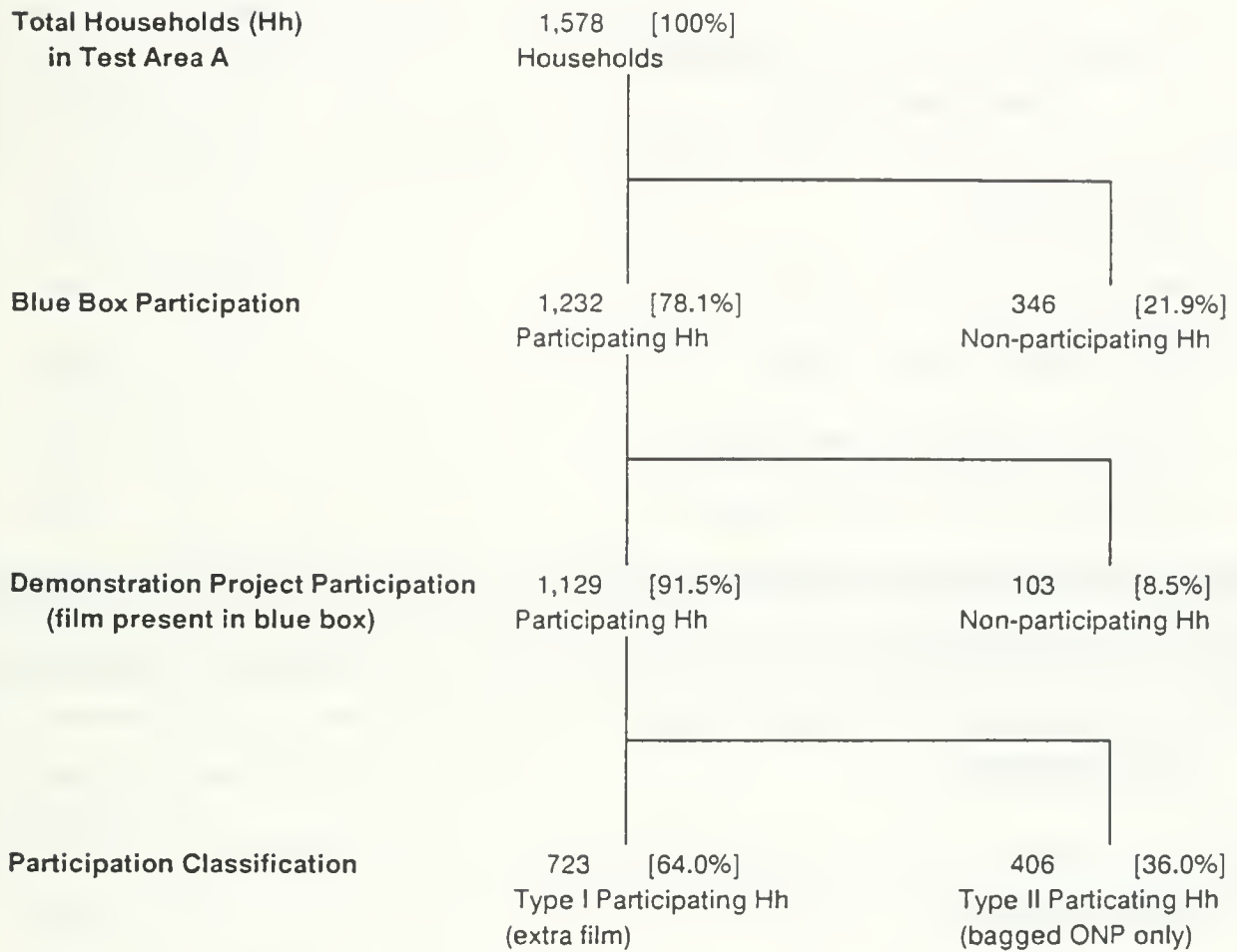
Table 5.1

Summary of Participation Study
Study Area "A"

PARTICIPATION IN BLUE BOX PROGRAM (four week period only)	No. of Homes	Percent of Study Area
Did Not Participate	346	21.9%
Set Out Blue Box Once In 4 Weeks	324	20.5%
Set Out Blue Box Twice In 4 Weeks	311	19.7%
Set Out Blue Box Three Times In 4 Weeks	303	19.2%
Set Out Blue Box Four Times in 4 Weeks	294	18.6%
TOTAL BLUE BOX PARTICIPATION DURING 4 WEEKS	1232	78.1%
TOTAL HOUSEHOLDS	1578	100.0%
PILOT PROGRAM	No. of Homes	Percent of Study Area
Did Not Include Film	449	28.5%
Included Film Once in 4 Weeks	367	23.3%
Included Film Twice in 4 Weeks	305	19.3%
Included Film Three Times in 4 Weeks	256	16.2%
Included Film Four Times in 4 Weeks	201	12.7%
INCLUDED FILM AT LEAST ONCE IN 4 WEEKS	1129	71.5%
TOTAL HOUSEHOLDS	1578	100.0%

Figure 5.5

Test Area A - Participation Results



Note:

- (i) the overall participation of Hh with film in their blue box is 72% of total households.
- (ii) the overall participation rate for Type I participation is 46% of total households.

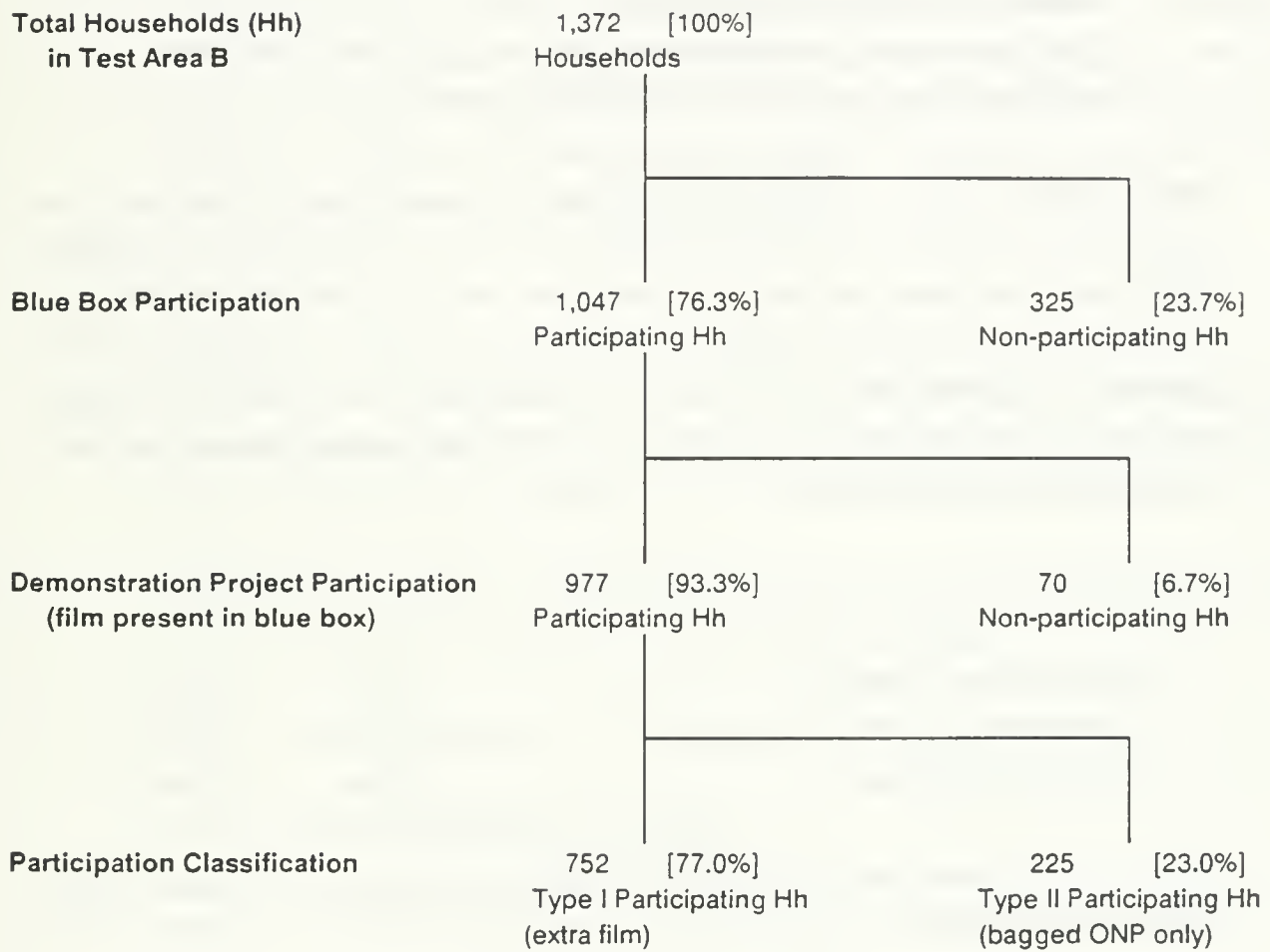
Table 5.2

**Summary of Participation Study
Study Area "B"**

PARTICIPATION IN BLUE BOX PROGRAM (four week period only)	No. of Homes	Percent of Study Area
Did Not Participate	325	23.7%
Set Out Blue Box Once in 4 Weeks	259	18.9%
Set Out Blue Box Twice in 4 Weeks	300	21.9%
Set Out Blue Box Three Times in 4 Weeks	241	17.6%
Set Out Blue Box Four Times in 4 Weeks	247	18.0%
TOTAL BLUE BOX PARTICIPATION DURING 4 WEEKS	1047	76.3%
TOTAL HOUSEHOLDS	1372	100.0%
PILOT PROGRAM	No. of Homes	Percent of Study Area
Did Not Include Film	395	28.8%
Included Film Once in 4 Weeks	287	20.9%
Included Film Twice in 4 Weeks	299	21.8%
Included Film Three Times in 4 Weeks	227	16.5%
Included Film Four Times in 4 Weeks	164	12.0%
INCLUDED FILM AT LEAST ONCE IN 4 WEEKS	977	71.2%
TOTAL HOUSEHOLDS	1372	100.0%

Figure 5.6

Test Area B - Participation Results



Note:

- (i) the overall participation of Hh with film in their blue box is 71% of total households.
- (ii) the overall participation rate for Type I participation is 55% of total households.

- Blue Box participant - a household that places a blue box at the curb at least once in four weeks,
- Demonstration Project participant - a household that places a blue box with plastic film at the curb at least once in four weeks,
- Type I participant - a demonstration project participant identified as placing additional plastic film in their blue box, and
- Type II participant - a demonstration project participant identified as placing only plastic bags containing ONP in their blue box.

Results indicate that of those households already participating in the blue box program (78% in Test Area A and 76% in Test Area B), over 90% placed plastic film in their box during the demonstration project, and of these, 64% to 77% took the extra effort to separate additional plastic film from their waste stream at the minimum frequency level or better. In summary, the following program participation was determined for those households participating in the blue box program in each test area:

	A	B
■ Blue box participation	100.0%	100.0%
■ Demonstration Project participation	91.5%	93.3%
■ Type I participation	58.0%	71.8%

When all households that have access to blue box collection are included in the analysis, all participation rates are lowered as follows:

	A	B
■ Total test area households	100.0%	100.0%
■ Blue box participation	78.1%	76.3%
■ Demonstration Project participation	71.5%	71.2%
■ Type I participation	45.8%	54.8%

Type I participants are expected to represent a true program participant (e.g. a household that actually changed behaviour and began adding plastic films when requested). The percentage of Type II participants who were true program

participants could not be quantified but it is felt that this percentage would be small. However, this participant category represents an ideal target that could be 'convinced' to add other plastic bags and films because they already are completing a portion of the work required to add these materials.

Those respondents classified as Type II participants were surveyed to determine reasons why they did not take the extra effort to place additional film in their blue boxes. Results are shown in Table 5.3. The most common reason given was that they were not aware of the demonstration project. Many also claimed that it was too time-consuming to source-separate plastic film.

Observations

Through the follow-up questionnaire, it was determined that 2.5% of respondents changed their previous methods for setting their newspapers at the curb and began using plastic bags for this purpose due to the demonstration project.

Only 6.3% of the Type I participants claimed that they placed their blue box at the curb more frequently because of the demonstration project.

5.4 Capture Rate Analysis

5.4.1 Capture Rate Demonstration Study

Purpose

The purpose of the capture rate demonstration study was to determine the quantities of plastic film resin types that are collected in the blue box of a participating household in relation to the quantities generated in that household.

Methodology

During one week of the collection period, blue box materials and all garbage set at the curb were removed from 35 participating households in each test area. Participating households were determined from the participation study which had ended the previous week.

Table 5.3

Questionnaire Results: Type II Participation (bagged ONP only)

Reasons for Not Placing Extra Film in Blue Box	Respondents	
	Test Area	
	A [34]*	B [24]*
Inconvenient or time-consuming	32%	29%
Do not throw out plastic bags or film	24%	21%
Was not aware of the pilot project	32%	54%
Did not understand purpose of pilot project	6%	4%
Information provided not clear	0%	8%
Other	24%	29%

* number of responses

The participants were grouped into Type I and Type II classifications: Type I participants had extra plastic film in their blue box; Type II had bagged ONP only in their blue box. From each household's waste, plastic film present in the blue box and remaining in the garbage stream were sorted into categories and weighed. The quantity of plastic film present in each blue box was divided by the number of weeks since the last set-out for that household (recorded in the participation study) to estimate the quantity captured per week. The capture rate was calculated for each film type as:

$$\text{capture rate} = \frac{\text{total quantity in blue box (captured)}}{\text{total quantity generated (blue box + garbage)}} \times 100\%$$

Results

The results of the 'snapshot' view of capture rates for each plastic film resin type are presented in Table 5.4 for the two test areas. Separate results are shown for the two participation classifications.

Results indicate that the capture rate for LDPE and HDPE type films are higher than for laminates, PP/PVC/PVDC, and other films. LDPE and HDPE bags are likely easier to identify and separate by the householder, whereas the other types of films are more often used in food packaging applications and might require more effort to separate and clean.

Overall capture rates for plastic film for each participant type were calculated by applying the percent composition of each resin type in the quantity collected (from Figure 5.3) to its capture rate (from Table 5.4). These percentages are then added together with the results as follows:

Test Area A: Type I Participants	-	48.5%
Type II Participants	-	3.8%
Test Area B: Type I Participants	-	46.4%
Type II Participants	-	4.8%

Table 5.4
Capture Rate Analysis

Test Area A

I. Type I Participants (extra film)

Number of households: 22

Flexible Plastic Film Resin Type	Households Generating Resin Type	Capture Rate	Reuse Rate
LDPE	100%	49%	13%
HDPE	91%	51%	2%
LAMINATES	100%	43%	
PP/PVC/PVDC	100%	23%	
OTHER FILM	59%	23%	

II. Type II Participants (bagged ONP only)

Number of households: 13

Flexible Plastic Film Resin Type	Households Generating Resin Type	Capture Rate	Reuse Rate
LDPE	100%	4%	18%
HDPE	92%	4%	4%
LAMINATES	92%	0%	
PP/PVC/PVDC	100%	0%	
OTHER FILM	54%	0%	

Test Area B

I. Type I Participants (extra film)

Number of households: 23

Flexible Plastic Film Resin Type	Households Generating Resin Type	Capture Rate	Reuse Rate
LDPE	100%	47%	16%
HDPE	100%	31%	0%

II. Type II Participants (bagged ONP only)

Number of households: 16

Flexible Plastic Film Resin Type	Households Generating Resin Type	Capture Rate	Reuse Rate
LDPE	100%	5%	19%
HDPE	88%	0%	11%

Also shown is the reuse rate, determined by measuring the number of LDPE or HDPE bags reused as waste basket liners found in the householders' garbage stream. The combined capture rate and reuse rate for LDPE is similar for both test areas, 62-63% for Type I participants.

Observations

The questionnaire results indicate that 85% of those surveyed claim to reuse plastic bags for such uses as packaging lunches and lining waste baskets (Table 5.5). Few respondents take advantage of the bins provided for plastic bags at the grocery store.

5.4.2 Capture Rate and Recovery Rate Estimates

Overall recovery and capture rates for plastic film in each test area were also estimated for comparison using the information from the participation study and the weekly collected quantities, and an estimate of available quantities using the following:

$$\text{recovery rate} = \frac{\text{quantity recovered}}{\text{quantity available}} \times 100\%$$

$$\text{capture rate} = \frac{\text{quantity recovered}}{\text{quantity available} \times \text{participation rate}} \times 100\%$$

Quantity Available

Information available from the Society of Plastic Industry of Canada (SPI Canada) has been used to estimate the quantities of plastic film consumed by a typical household and, as a result, expected to be available for recycling programs ("Canadian Plastics End-Use Markets Analysis 1986-1996; Industry, Science and Technology and SPI Canada). The following assumptions were used to estimate the average quantity of plastic film available per year per capita:

- each person generates 400 kilograms of residential waste per year,

Table 5.5

Questionnaire Results: Reuse of Plastic Bags

Reuse/Recovery Practice	Number of Respondents Using Practice [200]*
Freezing food and packing lunches	85%
Lining waste baskets	85%
Reuse at grocery store	71%
Use bag bin at grocery store	2%

* number of responses

- plastics in the residential waste stream is estimated to be 6.5% by weight (26 kg/capita/year),
- plastic packaging represents 50% of the total plastics in the residential waste stream (13 kg/capita/year),
- plastic packaging consumption has been estimated as follows:

Plastic Packaging Type	% of Total Packaging	% of Residential Waste
bags and sacks	32%	1.05%
wraps	6%	0.21%
other films	9%	0.31%
rigid containers	26%	0.84%
other plastic packaging	<u>26%</u>	<u>0.84%</u>
	100%	3.25%

- kilograms of plastic film available per year can be estimated as follows:

	Quantity Consumed (kg/cap/yr)	Quantity Not Recoverable* (kg/cap/yr)	Quantity Available (kg/cap/yr)
bags and sacks	4.16	1.04	3.12
wraps	0.84		0.84
other films	<u>1.24</u>		<u>1.24</u>
Totals	6.24	1.04	5.20

* refers to plastic films that are used to produce garbage bags which would not be placed in the blue box

- therefore, at an estimated 2.7 people per household, the available quantity in each test area is 14.0 kg/Hh/year in Test Area A, and 8.4 kg/Hh/year (bags) in Test Area B.

Quantity Captured and Capture Rates

The quantity captured represents the quantity of plastic film that a participating household places in their blue box. The capture rate is this quantity as a percentage of the quantity available as determined above. The following assumptions were used in these calculation:

- each household is equivalent in terms of generation rates,
- 15% of the collected film previously was set out as packaging for newspapers (in the conveyor belt sorting analysis, the quantity of plastic film in the base case material was calculated to be 15% of the quantity in the test area material),
- the available quantities of plastic film are 14.0 kg/Hh/year in Test Area A and 8.4 kg/Hh/year in Test Area B,
- all households determined to be Type I or II participants set out ONP in plastic bags

The results of the calculation of quantity captured and capture rates for Types I and II participants in Test Areas A and B are presented as follows, (the detailed calculations are found in Appendix G).

Test Area A:

<u>Type I participant</u>	quantity captured	=	4.873 kg/Hh/year
	capture rate	=	4.873/14.0
		=	34.8%
<u>Type II participant</u>	quantity captured	=	0.495 kg/Hh/year
	capture rate	=	0.495/14.0
		=	3.5%

Test Area B:

<u>Type I participant</u>	quantity captured	=	3.717 kg/Hh/year
	capture rate	=	3.717/8.4
		=	44.3%

<u>Type II participant</u>	quantity captured	=	0.444 kg/Hh/year
	capture rate	=	0.444/8.4
		=	5.3%

The capture rates for Test Area B appear higher because the target plastic film quantity is smaller. The overall capture rates for Test Area A include the lower capture rates found for the laminates, PVC, and other films. Comparison to the results found in the pilot study indicate that these results are in the same order. The small differences may be attributed to the small sample size and short time frame of the pilot study, as well as the assumptions used in performing this calculation.

As was observed in the demonstration study, reuse rates ranged from 10% to 20% across the test areas and participation types. Reuse was measured as follows:

$$\text{reuse rate} = \frac{\text{quantity reused}}{\text{quantity available}} \times 100\%$$

Therefore, the combined capture and reuse rates for Type I participating households are:

- Test Area A: 35% capture + 10% to 20% reuse = 45% to 55%
- Test Area B: 44% capture + 10% to 20% reuse = 54% to 64%

Recovery Rate Calculation

The recovery rate expresses the quantity of plastic film collected in each test area in terms of all of the households in the test area, whether or not they were participants in either the pilot study or the blue box program:

Test Area A:	quantity recovered	=	2.36 kg/Hh/year
	recovery rate	=	2.36/14.0
		=	16.9%

Test Area B:	quantity recovered	=	2.11 kg/Hh/year
	recovery rate	=	2.11/8.4
		=	25.1%

In addition, it may be assumed that the findings regarding reuse rates in the demonstration study may be true for all households as this behaviour is not likely a result of the pilot program. Therefore, combined recovery rates and reuse rates may be in the order of:

- Test Area A: 17% recovery + 10% to 20% reuse = 27% to 37%
- Test Area B: 25% recovery + 10% to 20% reuse = 35% to 45%

5.5 Material Quality Analysis

Purpose

The purpose of analyzing material quality was to determine the levels of non-requested materials and contamination in the collected plastic film.

Non-requested materials are those materials excluded from the collection program as outlined in the initial information kit. The quantity of non-requested materials present in the collected plastic film are indicative of the amount of sorting required at the MRF.

Contamination refers to residue that remains with the requested material after the initial sort at the MRF. The residue fraction remaining indicates the quantity to be removed through washing procedures at the plastic recycling facility. It also provides information about the degree to which householders clean the plastic film before placing it in the blue box.

Methodology

Non-Requested Materials:

The collected material was sorted into the identified categories by the Project Assistant. Because of the detailed level of sorting undertaken to obtain information about quantities of film resin types, the results cannot necessarily be applied to the level of sorting that would typically take place at a MRF. Non-requested materials were measured for each test area load collected and classified as follows:

Test Area A - other plastics
 - other materials

Test Area B - other film (including laminates, PP/PVC/PVDC and other)
 - other plastics
 - other materials

Residue Contamination:

Samples of each acceptable resin type from the test areas were taken from the collected plastic film every four weeks during the demonstration project (6 samples of each category). The samples then were sorted into clean material, 'loose' residue (e.g., sales slips, price stickers, bread tabs, etc.) and material contaminated with food residue, and weighed. The contaminated material subsequently was washed and re-weighed to determine the quantity of 'attached residue' (e.g., food residue, mold, etc.). Total residue includes both 'loose' and 'attached' residue fractions.

Results

Non-Requested Materials:

Figures 5.7 and 5.8 illustrate the average percentage of non-requested materials of the various categories for each test area. While 'other materials' made up a larger percentage of material collected in Test Area A than B (4.7% in A compared to 2.2% in B), the fraction of materials in the 'not acceptable' category is similar for both (5.6% in A compared to 4.4% in B).

Figure 5.7

Test Area A: Average Composition of Collected Material by Category

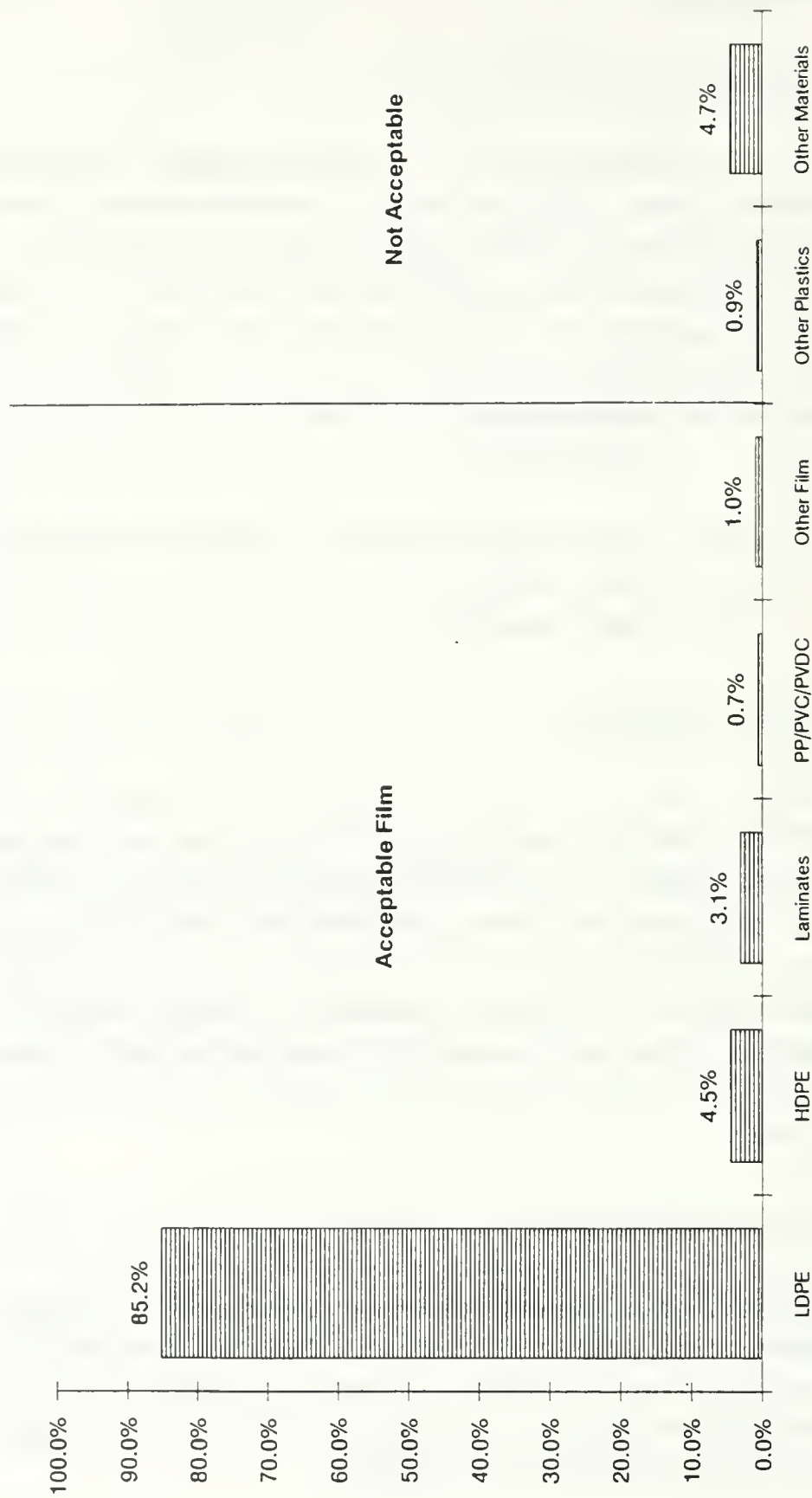
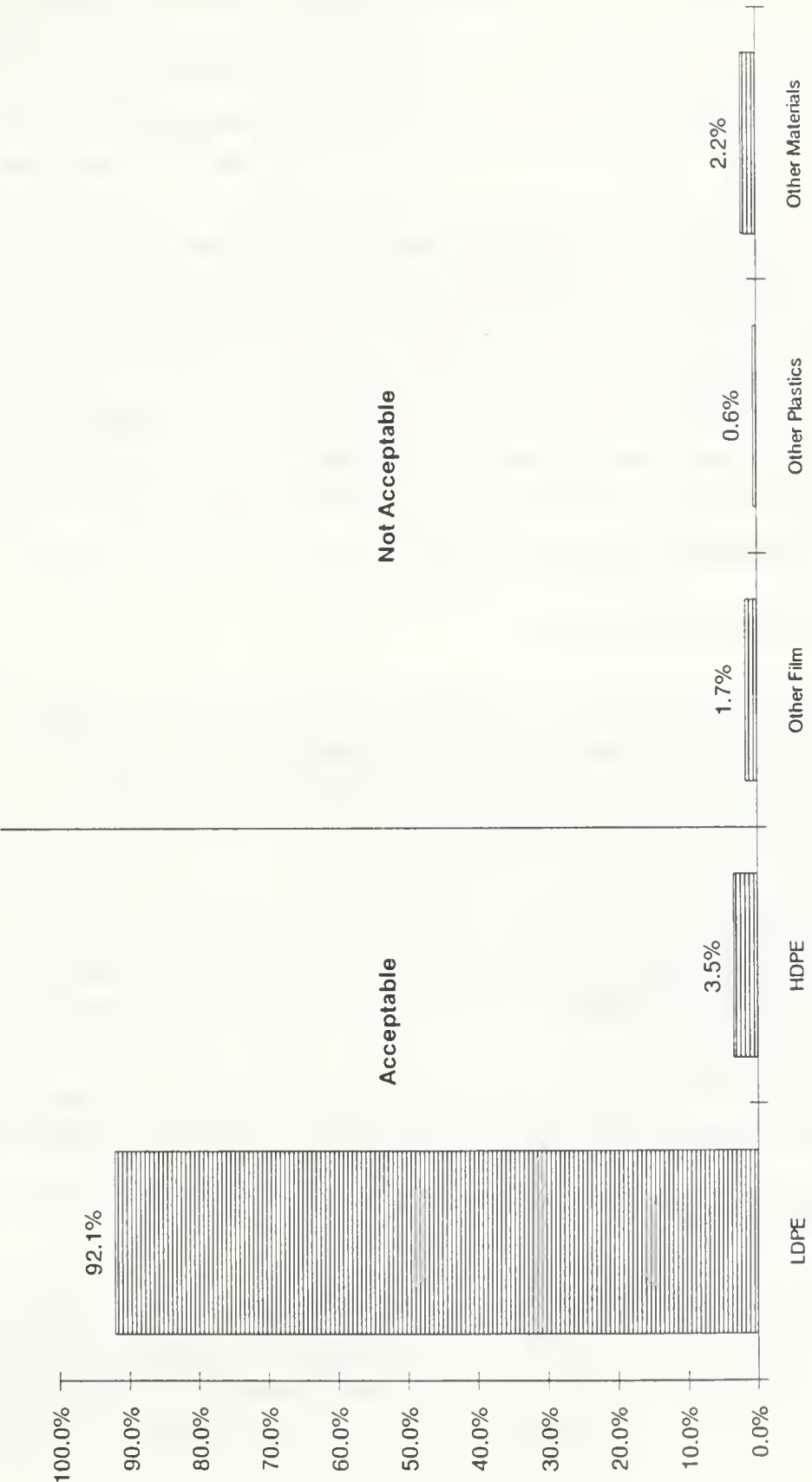


Figure 5.8

Test Area B: Average Composition of Collected Material by Category



This difference can be attributed to the greater number of materials and plastic film types allowed in Test Area A. This may have caused the householder to practice less discretion about the materials placed into the Blue Box. Test Area B plastic films consisted primarily of grocery sacks and shopping bags, which are identified easily and generally require less effort to clean and source separate.

The quantity of non-requested materials is indicative of the quantity of material arriving in the plastic film at the MRF that would require removal. Results indicate that this amounts to approximately 5 to 6% (including residue contamination) of the materials arriving at the MRF in the ONP compartment. (Note: based on observations of the materials arriving in the ONP compartment in the test areas and from other collection routes in Peterborough, a considerable proportion of the non-requested materials were arriving previously and not attributable to the demonstration project.)

Residue Contamination:

Results for the residue contamination study are shown in Table 5.6. The quantity of residue found in the plastic film type samples was highly variable since the weight of residue found in one sample could be skewed by one large heavy object such as a stone. However, the average quantity of residue contamination found in the individual plastic film types indicates a low percentage in polyethylene films, and higher percentages present in PP/PVC/PVDC films. This is likely due to the nature of the use of the plastic films. The majority of polyethylene present is in the form of grocery and shopping bags. The other films are more likely to be used as food packaging and therefore, have a greater chance of becoming contaminated. The total residue contamination remaining in the material collected in both test areas is approximately 0.6%, which is not significant in terms of processing requirements.

Observations

Minimal quality control was required at the curb by the driver due to diligence of the householder in placing clean materials in the blue box. This, in part, is due to the amount of public education and promotional material provided to the householder and the willingness of the test area householder to follow instructions.

Table 5.6

Residue Analysis

TEST AREA A

Resin Category	% Residue in Resin Category	% Composition of Plastic Film Collected	*Residue in Collected Plastic Film
LDPE	0.5%	90.1%	0.46%
HDPE	0.9%	4.8%	0.04%
LAMINATES	1.2%	3.3%	0.04%
PP/PVC/PVDC	3.4%	0.8%	0.03%
OTHER FILM	1.3%	1.1%	0.01%
TOTAL			0.58%

TEST AREA 'B'

Resin Category	% Residue in Resin Category	% Composition of Plastic Film Collected	*Residue in Collected Plastic Film
LDPE	0.6%	96.4%	0.57%
HDPE	0.7%	3.6%	0.02%
TOTAL			0.59%

*Sample calculation:

residue in collected plastic film = %residue in resin category x %composition of plastic film collected
 Test Area A: LDPE = 0.5% x 90.1% = 0.46%

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(Note: material can also be screened at the curb to remove non-requested materials for the blue box collection programs that experience a high contamination rate. In addition, non-requested materials can be removed from the recyclable materials at the MRF.)

No trends (i.e., increase or decrease over time) in quantities of either non-requested materials or residual contamination or residual contamination over the six month collection period were identified.

Plastic film types used for food packaging often had food residue attached that was difficult to measure. Although the quantities were relatively small, this material resulted in unpleasant odours at times.

5.6 Conveyor Belt Sorting Analysis

Purpose

The householders were instructed to 'stuff' the plastic film into the same bag alongside the newspaper or in a separate plastic bag. The driver of the collection vehicle placed the plastic film into the same compartment as the newspaper so that no sorting was required at curbside. A plastic bag containing other plastic films would require only one additional toss onto the collection vehicle.

Observations of collection early in the demonstration project and discussions with the driver responsible for the test area collection routes indicated that there was not a measurable increase in time to collect the test area plastic film at the curb. Since the newspaper compressed the film in the ONP compartment, no problems were encountered with the compartment filling up or "cubing out". Therefore, the incremental time required to collect and sort film is accounted for primarily at the MRF following delivery of the materials. This time was measured through the conveyor belt sorting analysis.

The purpose of the conveyor belt sorting analysis was to determine the incremental increase in time required to sort the test area plastic film from the newspaper compared to the base case. The base case is defined as the time to sort the existing plastic film arriving in loads of newspaper from non-test areas.

Methodology

The conveyor belt sorting analysis was conducted during one week of collection in November, 1990, and again in March, 1991. The results from this pilot study reflect a snapshot view of sorting requirements to provide an indication of the additional time and cost associated with the collection of plastic film that would result at the MRF.

The method for the sorting analysis was not the method currently used at the MRF (Scott's Plains) to remove plastic film from the newspaper. The current method involves several sorters removing the film from the bucket of the front-end loader as it stands above the conveyor belt leading to the baler. Separate conveyor belts were used for the sorting analysis in order to control as many variables as possible to allow for easier measurement and comparison of trial runs. Although, this method was chosen as the most reasonable for this study given the available equipment and conditions, it represents only one possible method of sorting the plastic film and not necessarily the recommended method for all MRFs.

The material collected in one day was divided into a number of trial runs, to most effectively optimize the conditions for each run. A number of trials were run for each of the following cases:

- Test Area A material,
- Test Area B material, and
- base case material - loads of newspaper as normally collected in plastic bags from other blue box collection routes in Peterborough

(Note: during the second set of the analysis, only material similar to the original Test Area B material collected in the demonstration project was available for sorting.)

Trial runs were conducted as follows:

- the receiver container for ONP was weighed to determine the tare weight,

- during each trial, one person was responsible for maintaining a constant level of material on the belt; one to two people were responsible for sorting on the belt; (trial run times were translated into total sorting time, i.e. no. of sorters x trial time),
- belt speed was controlled to maintain a comfortable sorting speed (i.e., the speed was increased to minimize waiting periods between plastic film, and the speed was decreased when the concentration of plastic film was greater),
- plastic film was 'positively' picked and placed into bins adjacent to the sorters; ONP fell off the end of the belt into the receiver container,
- the sorting was continuous until the ONP filled to the marked level on the receiver container, at which time the timer was stopped and time recorded, and
- the plastic film and the ONP quantities were weighed and recorded.

Analysis of the data was based on the assumption that ONP is recovered in the same quantity per household from all areas sampled. This assumption allowed us to compare sorting times based on handling a unit (kg) of ONP. Also assumed is that the concentration of plastic film present in the base case would be equivalent to that found in the test areas before the commencement of the pilot project.

Results

On average for this study, it was found that there was an approximate increase of 85% in the time required to sort one kilogram of ONP in the base material to the time to sort one kilogram of ONP in the test area material. However, it should be noted that for each kilogram of ONP sorted there was 6.5 times more plastic film sorted in the test area material than the base case material.

Calculations shown in Appendix G express the results in terms of staff hours required to sort one tonne of test area material as well as the incremental time to sort one tonne of plastic film. A municipality that wishes to obtain a number that is more reflective of its own situation may apply local value for labour efficiency and

employee wages to these staff hour/tonne estimates to calculate an average cost relative to one tonne of ONP. This cost reflects the incremental cost for sorting the plastic film, and does not include revenue, handling, baling and transportation costs.

A sample calculation has been done (Appendix G) by applying the estimated incremental cost for sorting the plastic film to a city of equivalent size to Peterborough (assuming: 80% labour efficiency; \$10 per staff hour). The results indicate that the annual incremental cost attributed to the City would be an estimated \$12,000. Application of this cost to all city households results in a cost of \$0.57 per household per year (or an incremental cost of \$245/tonne for incremental tonne of plastic film). Also included in Appendix G is a scenario in which baling costs, landfill tipping fees, and revenue from the plastic film are considered in the overall costs.

Observations

Analysis of the trial run data indicated high variability between runs of test area material. Observations noted during the trial runs which may affect each individual trial time include:

- variability in depth of material due to cleat height (changes as it slides on belt despite efforts to maintain constant flow),
- uneven distribution of plastic film on the conveyor; this was due in part to the tendency of the plastic film to 'float' to the top when tipped onto the floor resulting in it being present at greater concentrations during the first few runs,
- variability in number of bags tied or fastened with twist ties, which required considerable time to open and remove newspaper,
- in loads with high concentrations of plastic film, much of it was easily removed (bags full of plastic film removed with one pick), and
- the more plastic film present, the faster the sorters removed plastic film from the belt

During the first set of trial runs, all runs were conducted with two sorters on the belt picking off plastic film. Observations of the sorting activities indicated that the sorters were not kept constantly occupied during the sorting of base case material (i.e., long lapses between pieces of plastic film), because they were limited by the highest speed of the conveyor belt. The next set of runs (March, 1991) were conducted with only one sorter on the base case material. Although this did not seem to be a limiting factor for the test area material (i.e., two sorters were kept relatively busy), trial runs were conducted with both one and two sorters for comparison. Results indicate that the total sorting time (trial run time x number of sorters) is slightly less per quantity of ONP using only one sorter.

Another interesting observation resulted from the comparison of trial runs of base case material compared to an equivalent quantity of only newspaper. It was found that the runs with only newspaper took greater time per run because the newspaper would slide back on the belt. In the base case material, where most of the newspaper is packaged in plastic bags, the material is held by the cleat and travels up the belt in larger quantities and less sliding on the belt results.

5.7 Marketing Plastic Film

The purpose of this section is to report the findings of the various market-related activities undertaken as part of this study and to describe a framework to establish the potential for marketing plastic film from curbside collection programs. The main activities include:

- baling plastic film at the MRF,
- shipping plastic film to processors,
- processing plastic film into a marketable feedstock, and
- converting pellets (low density polyethylene or polyolefin film pellets) into marketable end products.

The baling and shipping activities undertaken in the demonstration project are described in Subsections 5.7.1 and 5.7.2. A discussion of processing and converting films, presented in Subsections 5.7.3 and 5.7.4, relates experience gained in the demonstration project as well as other initiatives and experience. Subsection 5.7.4 begins with a discussion of potential markets for LDPE pellets and ends with a brief

overview of some of the market dynamics associated with marketing post consumer recyclable materials with particular emphasis on market development for plastic film. The last subsection provides a brief overview of a some other plastic film collection and recycling initiatives across North America.

5.7.1 Baling

Plastic packaging currently collected through blue box programs in Ontario generally is baled at the MRF to densify the material prior to shipment to plastic processing facilities, and to reduce both on-site and off-site storage requirements. Plastic film collected during the demonstration project was baled for these reasons and to demonstrate the capability of the baler used in Peterborough for this material.

All materials collected were sorted weekly, placed in large storage bags and labeled with the collection date and test area. The amount of material collected from the test area households did not justify baling on a regular basis. Instead plastic film was stored and baled twice during the project.

A total of three bales were prepared:

- Bale #1 contained only pre-sorted LDPE and HDPE collected over a 12-week period from Test Area A,
- Bale #2 contained all plastic films, except contaminants, collected during a 12-week period from Test Area B households, and
- Bale #3 contained all material, except contaminants, collected during a nine week period from Test Area A households.

The following activities were undertaken in baling the plastic film:

- identifying the test area materials to be baled in order that the bale contain known quantities of plastic film resin/category types received at the MRF during a specified period of the demonstration project,
- opening the storage bags beside the in-pit conveyor and hand-feeding the sorted plastic film onto the baler conveyor belt, and

- 'metering' into the mix the plastic film types that were collected in small quantities (e.g. laminates, etc.) during the specified period.

After the densification process, the baler 'tied-off' the bale with wire using an automatic tying mechanism. The bale was then lifted by forklift and placed on a wooden pallet.

The dimensions and weight of the first two bales are as follows:

- Bale #1: 2m x 1m x 1.2m (length x width x height) at 812 kilograms
- Bale #2: 2m x 1m x 1.2m (length x width x height) at 778 kilograms

Observations

- The plastic film was transported by the conveyor without any problems. Belt depth averaged 30 cm and, at times approached a depth of 45 cm,
- The baler 'cycled' without any problems,
- Some water was evident as the plastic film was being compressed,
- As the bale was pushed from the bale chamber the auto-tie worked as expected. However, additional tension was evident on the wires due to some expansion (i.e. memory) of the plastic film,
- There were no differences in any of the operational aspects of the baler during the baling of the three bales from test area material, and
- The baler used at the MRF in Peterborough performed well, above the expectations of both the facility staff and the baler manufacturer representative who was present during the baling process (Bales #1 and #2).

Results indicate that plastic film can be baled and that the bales achieved a very good density. (Note: the bale densities achieved in Peterborough for the plastic film and ONP were very similar.)

5.7.2 Shipping

All bales were placed on a regular transport trailer using a forklift. No special requirements were necessary at the MRF, on the vehicle or at the plastic processing centre.

5.7.3 Processing

The recycling of plastic film is not new. However, most of the existing technology has been developed for processing post industrial scrap rather than mixed post consumer material. As post industrial plastic film tends to be fairly homogeneous (i.e. material composition and contamination are often known and well controlled), it is considerably easier to process than mixed post consumer plastic film.

Although a comprehensive review of plastic film processing technologies was not part of this study a general overview of plastic film processing is provided, followed by a brief outline of the processing of the material collected from the demonstration project at Resource Plastics Corporation in Brantford, Ontario.

General Overview of Plastic Film Processing

A few technologies for cleaning and processing plastic film exist although most commercial operations rely on manual sorting (if sorting is required). Mechanized sorting of plastic film is still in an early stage of development. Currently, most plastic film processing systems remove some individual resins as 'contaminants'. A complete list of companies that offer various plastic film recycling systems and system components can be obtained from EPIC. Companies that offer either complete systems and technologies for plastics recycling or individual components of a system or technology may be classified by the feedstock they process as follows:

- single resin cleaning and processing,
- mixed resin separation, cleaning and processing, and
- mixed resin processing and extrusion.

Technologies used for these three categories have minor variations. The first two categories have the potential to produce pellets or flakes with specifications and

end uses similar to virgin resins. Markets for recycled pellets or flakes are potentially large, and the pellets could have a high value if all specifications can be met.

Processing and extrusion of mixed resins (e.g. plastic lumber) typically create products of relatively low value. They depend generally on large scale, low-cost processing to be competitive. With technological modifications, rigid plastic containers and other plastic packaging types can be added as feedstock to most existing systems and technologies.

Processing plastic films from the post consumer waste stream presents several challenges:

- removing contaminants, such as paper, metal and residual product,
- effectively processing very thin gauged material (less than half a mil, such as that used for some wraps and bags), and
- creating a pellet or flake that is capable of meeting market specifications with the understanding that some incompatible resins may be processed together (e.g. LDPE and PVC).

Although each plastic film recycling system is unique and in many cases proprietary, there are components that tend to be common to all systems. A brief description of the common components is as follows:

Manual Sorting	This step often begins with plastic film arriving in a bale which is 'cracked' open. This is followed by the removal of contaminants from the feedstock. Manual separation of resins can occur at this stage.
Granulation or Shredding	This step reduces the plastic to a more uniform size. The granulating activity can be completed as a wet process or a dry process. An advantage of the wet system is that it acts as a 'pre-washing stage'. Also, it may act as a 'lubricant' and add to the life of the

granulator. In some systems granulation can be replaced and/or preceded by shredding.

Washing This step removes contamination, such as residual product, labels and adhesives during intensive agitation. The washing process can include a caustic or detergent bath and/or a hot water bath. Mixing drums, centrifugal pumps, tanks and hydrocyclones are common pieces of equipment used in the washing process.

Resin Separation This step removes contaminants or undesired materials from the target stream. A few processes are available with the most common being flotation separation (float/sink tanks or hydrocyclones) to separate denser fractions from lighter fractions. Wetting agents may be used to enhance the separation activity.

Dewatering or Drying This step removes a large percentage of the moisture and relatively large contaminants. A centrifuge or filter press are common techniques used for dewatering.

Secondary Shredding This step involves a fine shredding process to produce a marketable flake product. The flakes are likely to be packed into large bags or other types of containers.

Pelletizing This step extrudes fine material (e.g. flakes) to a pellet-like product.

Processing Plastic Film Collected from the Demonstration Project

The three bales prepared during the demonstration project were shipped to Resource Plastics Corporation in Brantford, Ontario. Bales #1 (only LDPE and HDPE from Test Area A) and #2 (all requested Test Area B plastic films) have been processed. To date, about half of Bale #3 has been processed. The remaining portion of Bale #3 will be processed after some modifications are made to the facility.

The material from the demonstration project passed through the following basic process steps: shredding, washing, separating, drying and pelletizing. A detailed description of the process used by Resource Plastics is not available as it is considered proprietary.

All processed LDPE pellets from Bales #1 and #2 were placed into large storage containers, labeled, and shipped to research laboratories at Du Pont Canada Inc. and Novacor Chemicals Ltd. for analysis. Half of Bale #3 is currently being analyzed at Dow Chemical Canada Inc.

In summary, the first two bales of plastic films from the demonstration project were successfully processed into LDPE pellets. Only minor problems were encountered during the recycling process (e.g. pellet cracking due to gases associated with the inks, etc.). Further difficulties were encountered when processing Bale #3. Independent investigations are currently under way to isolate the problem areas and determine probable causes. This work will include a detailed pellet analysis comparable to the work performed on the pellets produced from the first two bales.

For further information regarding the results, the reader is asked to send a written request to EPIC. A technical report summarizing this information will be available from EPIC at a later date. The processing of Bale #3 (all requested plastic films from Test Area A) will be reported upon in this report when full results are available.

5.7.4 Converting Low Density Polyethylene Film Pellets into Marketable End Products

Results obtained in the research laboratories of Du Pont Canada Inc. and Novacor Chemicals Ltd. indicate that the LDPE pellets can be used to replace up to 50% of virgin LDPE in certain packaging types such as garbage bags. These results were obtained by refiltering the LDPE pellets to enhance pellet quality. This step essentially simulates a change in the process used to produce LDPE pellets from the plastic film collected during the demonstration project.

This subsection provides a general overview of the market dynamics for recyclable materials in general followed by specific information regarding market opportunities for LDPE pellets.

Potential Markets for Processed Plastic Film

End markets for plastic film can be classified as either generic (resin recyclers) or commingled (mixed plastic recyclers). Generic recyclers are identified as end markets that require a particular resin with a fairly high purity. Generic recyclers generally purchase pellets or flakes. In many cases the post consumer product may be used as a substitute for virgin material.

Commingled recyclers include end markets that are able to process mixed plastics, both plastic film and other types of plastic packaging (e.g. juice containers, cleaning bottles, etc.) with a relatively high level of contamination. Generally, no sorting or cleaning is required before processing the plastic, and buyers traditionally prefer that the material be baled or densified.

The products commonly manufactured by these end markets:

- generic polyolefin (a generic term which includes HDPE, LDPE and PP) pellets as feedstock for plastic processing where a less desirable feed is permitted because end market specifications can still be met, and
- commingled "plastic lumber", processed from granulated and/or densified mixed waste plastic, which may serve as a replacement for some wood, concrete or metal applications.

The demand for post consumer polyolefin (PO) pellets causes them to compete in the marketplace with industrial scrap virgin resins. PO pellets are processed from a feedstock containing predominately LDPE, HDPE, and PP. They can be used in new plastic applications, however, buyer specifications for specific colours, quality, etc. often cannot be met using PO pellets.

A key objective of the demonstration project was to determine if the mixed polyethylene film collected could be cleaned and processed into polyethylene

pellets of high quality, and then converted back into light gauge film at a 25 to 50% blend with virgin resin. Plastic film manufacture is the most demanding end use because the process requires extruding a thin film of molten polymer through a circular die and inflating the subsequent bubble to a consistent and stable diameter. Impurities such as gas or particulates in reclaimed polyethylene could cause breakdown or instability in the blown film process and prevent its reuse in this application.

One of the most significant findings of the demonstration project has been the demonstration that mixed plastic (polyethylene) film collected from curbside in Test Area B can be processed back to film quality pellets in the process used by Resource Plastics (Note: based on the composition of plastic films collected in Peterborough, the pellets that were processed at Resource Plastics are referred to as LDPE pellets).

Plastic films under 1 mil (0.001 inches) thickness were manufactured with 50% recycled content. Also demonstrated was the manufacture of 1.5 to 2 mil films with 100% recycled content. This result should be qualified by the fact that the runs were relatively short and this will not necessarily represent the level of recycled content that can be achieved on all plastic extrusion lines. However, it is clear that a significant level of LDPE can be added to a number of existing polyethylene films. As a result, the recycled resin will have access to a very large existing market and can replace virgin resin sales in a number of end uses. This should provide more than adequate markets for the blue box plastic films collected in Ontario and other provinces in Canada as programs are established.

LDPE is currently used to manufacture a wide variety of plastic films for use in such products as garbage bags, recycling or composting bags, industrial bags, agricultural mulch films, general use films such as painter drop sheets, industrial over wrap films and tarpaulins. The recycled film will not be used in direct food contact.

The following (theoretical) projections provide an indication of the market potential for LDPE pellets in Ontario:

- 2.5 million households served by blue box in Ontario by late 1991 could generate 7,500 tonnes of plastic film assuming 3 kg/Hh/year (demonstration project estimate was 2.36 kg/Hh/year),
- 1991 consumption of plastic resin for film products in Canada is estimated at 435,000 tonnes ("Canadian Plastics End-Use Markets Analysis 1986-1996; Industry, Science and Technology and SPI Canada), and
- selecting those packaging categories where virgin resin replacement is most probable, approximately 9,000 tonnes of post consumer LDPE pellets could be used in the manufacture of plastic film products in Ontario (Table 5.7).

Table 5.7
Market Potential for LDPE Pellets, 1991

Packaging Type	Estimated Canadian Consumption	Estimated Ontario Consumption (a)	Virgin Material Replacement (b)	Potential Ontario Market Demand for LDPE Pellets (tonnes)
Grocery bags	58,000	23,200	10%	2,320
Merchandise bags	20,000	8,000	10%	800
Garbage bags	70,000	28,000	10%	2,800
Industrial shipping bags	50,000	20,000	10%	2,000
Drum liners	<u>24,000</u>	<u>9,600</u>	10%	<u>960</u>
TOTALS	222,000	88,800		8,880

Notes:

(a) assumes Ontario represents 40% (conservative) of plastic film production in Canada.

(b) virgin material replacement will vary by packaging type and within packaging type.

10% replacement was considered a 'conservative' estimate.

(Source: adapted from "Canadian Plastics End-Use Markets Analysis 1986-1996; Industry, Science and Technology and SPI Canada.)

Therefore, based on these calculations, enough capacity exists in Ontario to absorb the potential recoverable quantities from the residential stream given current institutional/commercial/industrial (ICI) recovery rates in Ontario. In the long term, additional quantities of ICI plastic film recovered will likely be greater than residential quantities. The larger quantities, as well as the greater degree of homogeneity of the material, may result in ICI plastic film displacing some residential plastic film end markets. There is, therefore, a challenge for industry to maintain sufficient diversified end market outlets for the less homogenous residential post consumer plastic film quantities at a price that supports continued collection and processing.

Post consumer recycled plastic content in an existing product has become a distinct marketing advantage. No guarantee can be given that markets will be found as quickly as collection can begin, but it is safe to say a large potential market already exists for this material if it is of plastic film grade quality.

Products made from mixed plastics recycling technologies compete in entirely different markets than plastic resins. Several proven technologies are currently operating in North America and Europe including the ET/1 (extrusion technology) process, the Superflow process, the Reverzer process and the Recycloplast process. Examples of products made from mixed plastic recycling technologies include plastic lumber, pipes, cable drums, and flower planters. These products have to compete directly with comparable products made from wood, concrete or steel.

While some of these technologies, or variations of, are represented in the United States, there is little commercial activity. The Superflow process is apparently commercially successful in Ireland.

Plastic lumber may not be able to compete on price alone with pine or pressure treated lumber. The cost of processing the material is such that the converters would have to be paid a tipping fee if the plastic wood product were to be competitive in price with pressure treated wood. If this occurred, the potential market for low priced plastic wood is very large compared to the available supply.

Based on the expected price for this product, its inherent attributes must be used as the selling feature including its durability, weatherability, rot-proof, splinter-proof,

and low maintenance. Plastic lumber can be made from 100% recycled post consumer plastic. Its marketability may be enhanced by being labeled an "environmentally friendly product" in Canada. The bottom line will be whether municipalities, industries and individuals are willing to pay the price in terms of tipping fees or product price premiums to make such products viable.

Recycled post consumer plastic must compete with virgin resins and existing non-plastic materials (e.g., paper for flower pots, wood for picnic tables, etc.). Recycled plastic, even if originally manufactured for the beverage and food industry, may not be used again for this particular application under current federal and provincial packaging regulations due to the potential for uncontrolled contamination.

Quality control is a definite concern with all potential purchasers, however, the range and level of contamination varies. Generic recycling firms that have dealt extensively with commercial/industrial sources of waste plastic often expect post consumer plastic to be of the same quality and consistency. Many firms are willing to clean post consumer plastic up to the required specification or find a low value use for the material. Mixed plastics recycling technologies are generally capable of withstanding a wide range of contaminants, but offer lower prices for plastic waste.

As noted previously, the plastic films collected during the demonstration project have proven to be easily processed, and current research indicates that they will be marketable.

General Understanding of Market Dynamics

The demand for traditional post consumer materials (often referred to as secondary materials) such as newspapers, steel and aluminum is well established. Secondary materials play a variety of roles as raw material:

- as substitutes for virgin materials,
- as supplementary materials used with virgin materials,
- as materials with their own special properties superior to virgin materials, and

- as low cost materials in applications where virgin materials are not economical.

The demand for post consumer materials varies as a result of two driving forces: the demand for the end product in which the post consumer material is used, and the relative cost of using a post consumer material compared to using a virgin material. The importance of the relative cost of using virgin versus post consumer materials is greatest when the ability to switch back and forth from one to the other requires the least effort. It may not be a factor where there is little economic justification to use virgin material (e.g., plastic lumber).

For most post consumer materials, use as a direct substitute for virgin raw materials is not feasible. Typically, process changes are required, process yields are different, and the end product specifications may be different than for products made from virgin materials. In some cases, regulations require that only virgin material can be used (e.g., plastic food containers, textiles).

Prior to purchase or acceptance, post consumer materials must meet material specifications. For example, there are over forty grade specifications of post consumer paper fibre, and similar diversity of material specifications exist for plastic, ferrous and non-ferrous metals, etc.

A significant concern of users and potential users of post consumer materials is the consistency with which they meet the required specifications. Materials containing unacceptable contaminants or not meeting specifications required for the production of the product can result in costly downtime or spoiled product. The resulting costs often far exceed the savings potential of purchasing a lower cost secondary material.

Users of post consumer materials must also be confident that sufficient quantities of material will be available at an acceptable price. Generally, the process required to manufacture a finished material or product from post consumer material is somewhat different than if virgin material is used. The production process equipment has to be set up to accommodate the expected material and material specification. For large scale processes (e.g., plastic processing, paper mills, steel

mills, etc.) the investments are substantial and are unlikely to be made if the supply of an adequate quantity of material is unreliable.

To achieve a significant increase in demand for any post consumer material, the following conditions must be met:

- the material must be a reasonably close and economical substitute for virgin material and the quantity of virgin material which it could replace justifies the substitution, or
- the material can be used in a product in which it is not a substitute for virgin material but for which there is a growing demand, and
- the industries making the investments to use the post consumer material as a feedstock are confident that a sufficient quantity, quality and grade of material will be available at an acceptable price.

The demand for post consumer materials at any given time will vary with general level of economic activity, the availability and price of virgin materials, available manufacturing capacity, seasonal and local factors and other conditions (e.g., strikes, equipment failures, etc.). The demand for all raw materials varies as the economy expands or contracts.

Weakening of demand for products leads to increasing inventories of raw materials; post consumer or virgin, manufacturers slow down or stop purchases of materials to avoid high carrying cost of inventory during slow economic periods. Through falling prices in a free market, the supply is reduced to accommodate the reduced demand. Typically, because of delays in 'turning off' supply, there will be a glut of material on the market.

The resulting volatility of material prices is characteristic of both virgin and post consumer materials, although typically post consumer materials prices are more volatile than for virgin materials. In some cases, this can be attributed to the high cost of storing post consumer materials relative to their value, making early sale at a low price more attractive than storage.

5.7.5 Other Plastic Film Collection and Recycling Initiatives

Curbside Collection

The curbside collection infrastructure for residential multi-materials (recyclables) exists in Ontario and a number of other provinces. The blue box has become the symbol of most recycling programs in Canada. In several Ontario locations new and innovative collection approaches such as wet/dry, three-stream, and blue bags in place of blue boxes, are being investigated. Most curbside collection programs collect, as a minimum, newspapers, glass containers, steel containers, aluminum containers and the 2 litre PET plastic soft drink bottle. Mixed rigid plastic containers (RPCs) and old corrugated containers have recently been added to a number of Ontario curbside collection programs.

Plastic film has been added to the blue box or innovative collection systems as a regular marketable material in few Ontario and other municipalities:

City of Mississauga

Plastic films are placed into the blue box along with mixed RPCs, other plastic packaging and products, newspaper, glass containers, steel cans and aluminum cans.

Town of Markham

Plastic films are placed into the blue box along with mixed RPCs, other plastic packaging and products, tetra brikTM aseptic cartons, newspapers, glass containers, steel cans and aluminum cans.

City of Guelph (pilot)

The Guelph pilot program is noted for its variations of the European wet/dry collection system (wet including kitchen scraps, yard waste and some soiled materials such as paper; dry including to all other materials such as paper, plastics, glass, steel cans, etc.). The 600 participating households are subdivided into three groups:

- Group A households received a 120 litre (26 gallon) green rigid plastic container for wet waste, a 240 litre (52 gallon) blue rigid plastic container for specified dry materials and are asked to place the remaining materials at the curb in bags or a different type of container. This technique is often referred to as three-stream collection.
- Group B households received only a 120 litre green container for wet waste and are asked to place the remaining dry materials at the curb in bags or a container of their choosing. This is a true variation of the wet/dry collection system.
- Group C households received a 120 litre green container for wet waste and a 240 litre blue container for dry materials. This is a close resemblance to the European wet/dry collection system.

Each container is collected in a separate side-loading packer collection vehicle with an automatic container lifting device. Plastic films are collected as a specified recyclable in the three pilot areas.

New Brunswick and Nova Scotia

Limited collection of plastic films at the curbside also occurs in New Brunswick and Nova Scotia. Householders are asked to place grocery sacks into the blue box along with other recyclable materials (Appendix H - PCL Group).

Store Depot Recovery and Recycling of Plastic Grocery Sacks

Plastic grocery sack (PGS) recovery at store depots and recycling has experienced a substantial growth during the past year. By the end of 1990 an estimated 10,000(+) supermarkets were participating in PGS recycling programs in Canada and the U.S. Currently four manufacturers produce most of the PGSs used in North America.

- | | |
|--------------------------------|-----------------------------------|
| ■ Sonoco Products Company Inc. | Hartsville, South Carolina |
| ■ Mobil Chemical Company | Pittsford, New York |
| ■ Vanguard Plastics Inc. | St. Louis, Missouri |
| ■ PCL Group | Oakville, Ontario; St. John, N.B. |

Each of these companies helped to establish collection programs by providing retailers with collection depots, promotional material and a market for the PGSs. A detailed discussion on the activities of these four main companies plus the supermarkets involved in their programs is found in Appendix H.

5.8 Plastic Film Recovery from Schools

Plastic film was collected from Otonabee Valley Public School (Test Area A) and King George Public School (Test Area B) due to interest generated by the Public Information Sessions held at these schools. Sources of plastic film collected at the schools included:

- plastic film packaging from lunches and snacks,
- grocery sacks used to carry books and lunches to school, and
- overwrap from school supplies.

The Otonabee Valley Public School has a student and staff population of 382 with grades from junior kindergarten to grade 6. Approximately 50% of the students stay for lunch. The grade 2 class took on the project as their responsibility and performed the following activities:

- made presentations to the other classes on reduction, reuse and recycling of plastic film,
- sorted plastics,
- made posters, and
- collected plastic film from all classrooms.

The King George Public School has 420 students and 30 staff, with grades from junior kindergarten to grade 6. Approximately 65% of the students stay for lunch.

The plastic film was collected within both schools and picked up by the Project Assistant once per week. Quantities collected per week are as follows:

Otonabee Valley Public School	- 2.0 kg/week (5g/student/week)
	- 10 g/participating student and staff/week
King George Public School	- 0.9 kg/week (2g/student/week)
	- 3 g/participating student and staff/week

Observations:

A lot of enthusiasm for project was expressed by both students and staff. The involvement of the schools is important as it provides a venue for educating children about recycling activities. In turn, the students bring the information home. At the end of the demonstration project, students from Otonabee Valley sent a letter to the City, MOE and others asking that the City to continue collection of plastic film.

6.0 CONCLUSIONS AND SUMMARY OF FINDINGS

The objective of the demonstration project was to determine the feasibility of collecting plastic films in an Ontario blue box program. A list of issues and questions were presented in Chapter 3.0. These issues and questions formed the basis for preparing the detailed investigations carried out during the 28 week collection period. Listed below are the summary responses that address the issues and answer the questions based on the results of the demonstration project.

Source separation

- What quantity of non-requested materials may arrive with the plastic film and will the householder clean materials before placing them in the blue box?

The quality of the plastic films placed in the blue box was acceptable for processing. Observations at curbside and in the detailed sorting of the plastic film indicated that most residents took the extra time required to clean milk pouches and remove unwanted materials from inside bags (e.g. cash register receipts, bread clips, etc.).

The average percentage of 'non-requested' materials in Test Area A was 5.6% by weight while in Test Area B it was 4.5% by weight. 'Other materials' made up a larger percentage of material collected in Test Area A than B (4.7% in A compared to 2.2% in B). This difference could be attributed to the greater number of materials and plastic film types allowed in Test Area A. This may have caused the householder to practice less discretion about the materials placed into the Blue Box. Test Area B plastic films consisted primarily of grocery sacks and shopping bags, which are easily identified and generally require less effort to clean and source separate. (Note: based on observations of the materials arriving in the ONP compartment in the test areas and from other collection routes in Peterborough, a considerable proportion of the non-requested materials were arriving previously and not attributable to the demonstration project.)

The total residue contamination remaining in the material collected in both test areas was found to be approximately 0.6%, which was determined insignificant in terms of processing requirements.

- Will the householder provide the quality of material that can be sorted at a materials recovery facility (MRF) to meet end market processing specifications (free of paper and other contaminants)?

In the demonstration project, film plastics were initially separated from newspapers, and then further sorted into plastic film types and non-requested materials removed. However, it is anticipated that both activities would be combined into a single step.

Assuming that non-requested materials can be removed at the MRF, discussions with end markets and other technical specialists indicate that the material quality provided by the householders was acceptable and that contamination levels were below levels that might cause concern.

- Are there differences in the quantity and quality of plastic films collected if different lists of requested materials are provided to the residents of different collection areas?

There was more plastic film collected per household in Test Area A than in Test Area B due to the longer list of requested materials. Quantities of non-requested materials and residue contamination were slightly greater in Test Area A. Results are currently not available from technical laboratories on the marketability of pellets processed from the two different collection areas.

The average weekly quantities (recovered over all households in the test areas) of plastic film materials (as requested in the project information kit) were:

- Test Area A - 45.3 grams/Hh/week (2.36 kg/Hh/year), and
- Test Area B - 40.6 grams/Hh/week (2.11 kg/Hh/year).

Comparison of quantities of plastic film types collected per household per week in each test area indicate that there is little difference in the quantities collected of LDPE and HDPE between the test areas:

- Test Area A - 40.9 grams LDPE/Hh/week (2.13 kg/Hh/year)
- 2.2 grams HDPE/Hh/week (0.11 kg/Hh/year)
- Test Area B - 39.1 grams LDPE/Hh/week (2.03 kg/Hh/year)
- 1.5 grams HDPE/Hh/week (0.08 kg/Hh/week)

■ Was the public relations program effective?

Feedback from attendees at the Information Sessions indicated that the Information Kits provided at the outset of the demonstration project were sufficient. In addition, survey results indicated that Type I participants (97%) found the information provided throughout the study was both informative and useful. However, many Type II participants claimed not to have been aware of the demonstration project.

Only a small percentage of the respondents in both test areas and in both participation types would have liked additional project information.

The fridge magnet was a popular component of the information kit as over 80% of the Type I participants in both test areas were still using it at the end of the demonstration project. Almost all of the Type II participants were found to have discarded their fridge magnets.

Another means of program promotion may be needed to reach Type II participants. The limited area in which the demonstration project was conducted did not allow for other types of promotional activities. In a community where the addition of plastic film is city-wide such media as newspaper announcements, radio commercials, etc. may increase awareness of the program than door-to-door delivery as used in the demonstration project.

■ What is the participation rate?

Three participation types were determined for the demonstration project: Type I, Type II and non-participants. Type I participants are expected to represent a true program participant (e.g. a household that actually changed behaviour and began adding plastic films when requested). Type II participants were those which placed plastic film in their blue box only as ONP packaging.

Those respondents classified as Type II participants were surveyed to determine reasons why they did not take the extra effort to place additional film in their blue boxes. The most common reason given was that they were not aware of the demonstration project. Many also claimed that it was too time-consuming to source-separate plastic film.

For these and related reasons, a single participation rate would not be reflective of the study's results. Therefore, the following range of participation rates may be suitable for other municipalities:

- if the blue box program participation rate is known: assume that between 58% and 72% of the households that participate in the blue box program will add plastic film to their blue box. The top end of the range would represent a target plastic film participation rate to be achieved, and
- if the blue box program participation rate is not known: assume that between 46% and 55% of the total households serviced will add plastic film to their blue box. The top end of the range would represent a target plastic film participation rate to be achieved.

As a final note, participation rates in recycling programs have been shown to vary directly with the level of convenience provided to the participants, how well the program is promoted, the frequency of collection, whether or not the program is mandatory and how it is enforced.

- What quantity of plastic film will be recovered per household?, per participating household?

The average quantity of plastic film recovered per Test Area A household was 2.36 kg/Hh/year. In Test Area B, the average quantity collected was 2.11 kg/Hh/year.

The average quantity captured for a participating Type I household was 4.87 kg/Hh/year in Test Area A and 3.72 kg/Hh/year in Test Area B.

Collection

- What, if any, additional volume is required on the collection vehicles?

No additional volume was required on the collection vehicles to accommodate the plastic film quantities. The newspaper compressed the plastic film as it was collected.

- Will there be any incremental collection time?

No. There will be only a minor increase in time at the curb to collect plastic film if it is collected in the same compartment as newspaper. This minor increase would be due to the need to throw one more bag, on average, into this compartment. (Note: after following the drivers at the beginning of the study, it was determined that the increase in time at the curb was not measurable).

- Are additional collection vehicles required?

No. Peterborough's collection vehicles operated at near-capacity when the demonstration project began. On average, the drivers were on-route for eight to nine hours. During the demonstration project, the driver responsible for collection in the test Areas was completing his routes within the same time period. Therefore, no additional collection time was required.

- Does addition of plastic film cause vehicle cube-out?

No. An increase in material volume was observed in the newspaper compartment when the vehicle returned. On several occasions, the driver would return for the first drop earlier than normal. However, over a one day period the vehicle was not required to return more often than prior to the demonstration project.

- Is on-truck densification necessary?

No. As expected, the newspapers provided the on-board densification.

- Was there any difference at curbside between the collection areas?

In Test Area A, the smaller pieces of plastic films included in the PP/PVC/PVDC and other categories had the tendency to blow away as they were being thrown into the newspaper compartment.

- What is the most practical collection strategy?

It was determined that the most practical collection strategy for plastic films in Peterborough was to place the plastic films into the newspaper compartment. Implementation of curbside sorting of plastic films was considered by the Project Steering Committee. However, it was determined not to be practical for Peterborough's collection system.

Sorting

- What is the resin composition collected by weight?

The resin composition collected by weight for requested materials in each test area was as follows:

	A	B
LDPE	90.1%	96.4%
HDPE	4.8%	3.6
Laminates	3.3%	
PP/PVC/PVDC	0.8%	
Other Film	<u>1.0%</u>	<u> </u>
Total	100.0%	100.0%

■ Will there be any incremental sorting time?

On average for this study, it was found that there was an approximate increase of 85% in the time required to sort one kilogram of ONP in the base material to the time to sort one kilogram of ONP in the test area material. However, it should be noted that for each kilogram of ONP sorted there was 6.5 times more plastic film sorted in the test area material than the base case material.

■ Can existing MRFs in Ontario be used to sort this material?

Sorting plastic films from ONP was completed in Peterborough by using a conveyor belt. Plastic film was positively picked and placed in separate containers. Many MRFs in Ontario are designed to include a newspaper sorting line for the purpose of removing non-requested materials and contaminants in the newspaper prior to baling. This arrangement can easily accommodate a staff person with the responsibility of removing plastic film as a recyclable material (many MRFs in Ontario currently remove plastic and paper bags used as ONP packaging in this manner).

Other methods that are also used to separate non-requested materials from newspapers in Ontario include:

- mobile sorting tables that are loaded by front end loaders,
- sorting from the floor prior to material being pushed into a clean pile or directly onto the conveyor belt leading to the baler, and

- sorting from the inclined portion of the conveyor belt leading up to the baler (this can only be accomplished if collected newspaper is relatively contaminant-free).

Plastic films could be removed in any of these three other newspaper sorting approaches.

Processing and Marketing

- Will the MRF provide the quality of material necessary to meet end market processing specifications?

This has not been confirmed. The first two bales of plastic films from the demonstration project were successfully processed into LDPE pellets. Only minor problems were encountered during the recycling process (e.g. pellet cracking due to gases associated with the inks, etc.).

Further difficulties were encountered when processing the third bale. Independent investigations are currently under way to isolate the problem areas and determine probable causes. This work will include a detailed pellet analysis comparable to the work performed on the pellets produced from the first two bales. (Further technical information will be available from EPIC at a later date).

- Can the collected plastic films be processed into marketable pellets?

Results obtained in the research laboratories of Du Pont Canada Inc. and Novacor Chemicals Ltd. have indicated that the LDPE pellets can be used to replace up to 50% of virgin LDPE in certain packaging types such as garbage bags. These results were obtained by refiltering the LDPE pellets to enhance pellet quality. This step essentially simulates a change in the process used to produce LDPE pellets from the plastic film collected during the demonstration project. (Further technical information will be available from EPIC at a later date).

Plastic films under 1 mil (0.001 inches) thickness were manufactured with 50% recycled content. Also demonstrated was the manufacture of 1.5 to 2 mil films with 100% recycled content. This result should be qualified by the fact that the runs were relatively short and this will not necessarily represent the level of recycled content that can be achieved on all plastic extrusion lines. However, it is clear that a significant level of LDPE can be added to a number of existing polyethylene films. As a result, the recycled resin will have access to a very large existing market and can replace virgin resin sales in a number of end uses. This should provide more than adequate markets for the blue box plastic films collected in Ontario or other provinces in Canada as programs are established.

Post consumer recycled plastic content in an existing product has become a distinct marketing advantage. No guarantee can be given that markets will be found as quickly as collection can begin but it is safe to say a large potential market already exists for this material if it is of plastic film grade quality.

- Is this material suitable for co-mingled plastic manufacture (e.g. plastic lumber)?

Co-mingled plastic recycling technologies have much higher tolerance levels for contaminants. LDPE films are an essential part of the co-mingled mix because these plastic films tend to enhance the 'plastic lumber' finish.

APPENDIX A

GLOSSARY OF TERMS AND ACRONYMS

GLOSSARY OF TERMS AND ACRONYMS

The following provides a description of some of the working terms and acronyms used in this report. (Note: the definitions have been applied specifically to this project and may not necessarily be used in the same context for other similar projects.)

capture rate	refers to the percentage of the recyclable materials that are actually 'captured' from the recyclable materials available (generated) in a household. Capture rates vary for each recyclable material based on the ease of identification of a material, the material preparation requirements in the household, the amount of material consumed in the home, and program promotion and education.
centrifuge	a rotary machine with accessory containers for the separation by centrifugal force of substances having different densities.
contamination	materials collected with the plastic film that were not requested.
flexible packaging	includes paper, plastic, aluminum foil and cellophane that is coated, printed, laminated, coextruded and/or combined or used as a single material for packaging. Examples include grocery sacks, plastic/foil pouches, and shrink wrap.
HDPE	high density polyethylene
ICI waste	institutional/commercial/industrial (ICI) solid waste generated by institutional, commercial and industrial establishments.

LDPE	low density polyethylene
laminate	a plastic resin laminated with a resin from a different family of resins or with a non plastic material (e.g., paper, aluminum foil).
MRF	material recovery facility
MSW	municipal solid waste is a term that is often used to describe solid, non-hazardous waste that is generated by households (residential waste) and institutional, commercial and industrial establishments (ICI waste).
mil	a unit of length or diameter equal to one thousandth of an inch, or 25.4001 microns.
non-requested materials	refers to any material that arrived in the newspaper compartment that was not specified as a requested (acceptable) material in the householder information kit.
PE	polyethylene
PET	polyethylene terephthalate
PGS	plastic grocery sack
PO	polyolefin
PP	polypropylene
PS	polystyrene
PVC	polyvinyl chloride
PVDC	polyvinylidene chloride

participation rate	refers to the percentage of households that separate their recyclable materials on a regular basis (usually once a month as a minimum). Participation rates have been shown to vary directly with the frequency of collection, the level of convenience provided to the participants, how well the program is promoted, whether or not the program is mandatory, etc.
plastic film	a shortened version for flexible plastic packaging that was used specifically for the Demonstration Project. It also replaced the use of the term flexible plastic film.
post consumer	a material that has been discarded by a consumer (e.g. householder)
post industrial	a waste or by-product generated by an industry or manufacturer.
processing efficiency	processing efficiency rate (PER) refers to the percentage of a recyclable material that is actually sent to market after it has been processed (e.g. baled, colour separated, etc.) at a MRF. For example, glass containers that fall off a sorting line may break on the floor and become part of the residue stream.
quantity available	refers to the quantity (tonnes) of a recyclable material that is discarded by households <u>served</u> by blue box and apartment recycling programs, referred to as the target residential waste stream. The quantity is estimated using two common method: - waste composition data - per capita generation data (actual data or consumption data).

quantity recoverable	refers to the quantity (tonnes) of a recyclable material potentially recoverable from households <u>serviced</u> by blue box and apartment recycling programs, referred to as the target residential waste stream.
recovery rate	refers to the percentage of a specified recyclable material that is recovered from the quantity potentially available.
residential waste	includes waste generated from households, and is defined as solid, non-hazardous waste. It is sometimes referred to as "domestic waste".
residue contamination	refers to the residue that was removed from the plastic film during the Residue Analysis. This term was used to differentiate between non-requested materials.
reuse rate	refers to the percentage of a material that is identified as being reused for the same application or for a purpose other than its originally intended purpose.
rigid plastic containers	a term that describes all plastic jugs, bottles and tubs.
study area	the area within the city identified as the target population with respect to the Demonstration Project.
target residential waste	refers to solid waste generated by those households served by a blue box and/or apartment recycling program.
test area	the subsections within the study area.
Type I participation	is defined as a household with extra or additional plastic film in their blue box.

Type II participation

is defined as a household with plastic film in their blue box only used as packaging for the newspaper, such as a grocery sack.

APPENDIX B

EXTRACTS FROM BARRHAVEN DEMONSTRATION PROJECT

BARRHAVEN DEMONSTRATION PROJECT:
"COLLECTION OF RIGID PLASTICS CONTAINERS
IN THE BLUE BOX"

Report prepared for and sponsored by:
Ontario Ministry of the Environment
The Society of the Plastics Industry of Canada
TransOntario Plastics Recovery Inc.

Report prepared by:
TransOntario Plastics Recovery Inc.

NOVEMBER 1989



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EXECUTIVE SUMMARY AND CONCLUSIONS

The scope of this demonstration project was to obtain data on factors impacting upon the **addition** of the collection of rigid plastic containers to an existing curbside Blue Box system.

The following conclusions were obtained:

- Blue Box collection of rigid plastic containers **is indeed feasible and plastic should** be added to the products recycled in the Blue Box.
- To collect plastics from Barrhaven's 5800 homes required four vehicles **but not on-board reduction equipment. The amount of other recyclables had been increasing prior the pilot.** To accommodate plastics, the incremental sorting time per route was approximately one-half hour/day when collecting loose uncompacted rigid plastic containers.
- Plastic containers collected **averaged 7 lbs/household/year overall** for Barrhaven during the 24 weeks of study or **17 lbs per participating household per year.**
- Residents of Barrhaven are willing to divert plastic containers from landfill with other recyclable materials: glass, steel, aluminium, and newspaper.
- Densification of the plastic containers was not necessary during the course of the pilot study. Equipment used for densification during the pilot study may require modifications for application in the future. Other prototype equipment and sorting protocols should be investigated for more efficient densification in the future.
- Careful education/ promotion, directed to the participating householder prior to and during the study, minimized contamination and facilitated participation.
- Post-consumer plastics recycled were: **PP/PE-75%; PET-12% ; and other (PS/PVC)- 13%.**

A note to future designers of collection systems for plastic containers: the volume and quantity of plastics collected did not warrant the use of densification equipment. Monitoring of participation and quantities of plastics in existing and future programs MAY POINT TO MODIFICATION OF EITHER ROUTES, OR VEHICLE CAPACITY AND ,THEN, DENSIFICATION EITHER ON-VEHICLE OR AT THE SITE OF OFFLOADING/ SORTING .

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ABSTRACT

The Barrhaven pilot demonstration was undertaken to ascertain the added effort/equipment involved, the actual quantities, and types of plastics collectible, in Municipal Solid Waste (MSW) when rigid plastic containers are added to an existing BLUE BOX project. The results from this project should be of benefit to municipalities contemplating the addition of plastics and to recycling operators.

The scope of the project was to obtain data on the impact of the addition of rigid plastic containers upon an existing curbside Blue Box system.

By weight, rigid and flexible plastics constitute about 5 - 7% of the estimated 10 million tonnes of (MSW) landfilled annually in Ontario. By volume, plastics take up 3 to 4 times this percentage.

Prior to the project the amount of other recyclable materials had been increasing. Four trucks are required to collect these materials from Barrhaven's 5800 homes. To collect plastics no on board reduction equipment was required but additional sorting time was, approximately one half hour per day.

The project was carried out over a 24 week period with an average participation rate of 51% (participation based on households putting out plastics at least once every four weeks). The average quantity of plastic containers collected was 7 lbs./household/year, based on 5800 total households.

For 9 weeks during the study the quantities of plastics from those households that set out plastics averaged 0.66 lbs./Blue Box. Data on frequency of participation indicated that the average household recycled on a biweekly basis. Therefore it was estimated that about 17 pounds of plastic could be expected per annum, from those households that recycle plastic.

The types of plastic collected were: PP/PE-75 %; PET-12 % ; and other (PS/PVC)-13%.

The project included a careful education and promotion component directed at the householder prior to and during the study. This facilitated participation and minimized contamination.

The volume and quantity of plastics collected did not warrant the use of densification equipment on the trucks. By monitoring householder participation and the quantities of plastics collected, adjustments to routes or vehicle capacity could be implemented before additional trucks or on-board densification equipment are required. The site for off-loading and procedures to sort plastics, particularly with the addition of flexible plastics, should be examined.

The objectives of the pilot study were met. The addition of plastic containers to a Blue Box multi-material curbside collection system is feasible. The addition of plastics will likely increase Ontario recyclers' revenues.

APPENDIX C

TYPICAL HOUSEHOLD PLASTIC FILM PACKAGING AND RESIN TYPES/CATEGORIES

Table C.1
Size and Weight of Representative Plastic Films

Description	Size (cm) (l X w)	Weight (grams)
Low Density Polyethylene		
Grocery Bag	36 X 34	8.00
White Bag	51 X 41.75	9.54
Large Shopping Bag	36 X 36	16.40
Diaper Outer Bag	67.5 X 54.5	46.00
Muffin Bag	32.5 X 17.5	4.45
Stationary Bag	61 X 45.5	26.50
Photo Film Bag	31 X 22.5	4.24
Diaper Outer Bag	46.5 X 46	31.89
Milk Outer Bag	45.9 X 31.2	9.40
Shopping Bag	50.5 X 56.1	22.91
Garbage Bag Outer Bag	26.1 X 18.6	4.00
Shopping Bag	35.8 X 27.5	7.68
Grocery Bag	58.5 X 48.8	12.41
Suit Cover Bag	134.8 X 63.5	50.90
Food Protection Bag	38.3 X 25.4	2.14
Diaper Outer Bag	48 X 50	38.08
Suit Cover Bag	133.7 X 64.1	12.47
Diaper Outer Bag	37.1 X 46.9	27.23
Peanut Bag	56.9 X 30.8	20.59
Frozen Food(Corn) Bag	33.6 X 18.4	7.35
Prescription Bag	30.7 X 22.4	3.74
Paper Towel Bag	40 X 27.7	7.83
Milk Outer Bag	45.6 X 31.4	9.99
Shopping Bag	43.2 X 35.4	23.53
Bread Bag	47.7 X 25.5	7.94
Muffin Bag	35.1 X 17.5	4.23
Bread Bag	33.2 X 27.3	6.58
Plastic Bag	36.7 X 20.4	2.37
Hot Dog Bun Bag	40.8 X 26	5.06
Apple Bag	56.7 X 22.6	8.40
Plastic Cover	53.8 X 8.9	1.77

Description	Size (cm) (l X w)	Weight (grams)
Low Density Polyethylene		
Candy Bag	18.6 X 12.9	2.93
Perogie Bag	30.7 X 33.7	12.62
French Fry Bag	39.6 X 21.3	10.18
French Fry Bag	40.4 X 21	11.43
High Density Polyethylene		
Small Grocery Bag	44.25 X 26.5	2.88
Toy Shopping Bag	50.5 X 50.5	8.26
Shopping Bag	48.2 X 37.9	6.82
Grocery Bag	49.7 X 49.7	8.27
Laminates		
Chip Bag	35 X 21	8.94
Corn Snack Bag	20.25 X 13.5	2.64
Cheese Snack Bag	23.5 X 9.1	3.32
Potato Chip Bag	35.2 X 21.1	9.07
Pasta Bag	36.6 X 18.9	10.02
Spaghetti Bag	34.2 X 13	6.73
Mint Candy Bag	21.7 X 13.1	5.45
Small Cereal Multi-Pak Bag	36.2 X 10.1	4.03
Hot Dog Wrapper	17.1 X 13.1	3.80
Tortilla Chip Bag	23.6 X 13.8	3.32
Polyvinyl Chloride/Polyvinylidene Chloride/Polypropylene		
Cheese Wrapper	20.9 X 9.7	0.45

APPENDIX D

HOUSEHOLDER INFORMATION KIT

PILOT BLUE BOX COLLECTION PROJECT FOR FLEXIBLE PLASTIC FILM

Dear Peterborough Resident:

We are all aware of the need to reduce the amount of household waste going to landfill. One way to do this is to increase the number of materials that we place in our Blue Boxes.

Flexible plastic film is a future candidate for Blue Box collection, but tests have to be done to confirm this. Peterborough has long been known as a city with an active and successful Blue Box recycling program, operated by Scott's Plains Recycling Inc. It has also been used for a number of market research tests.

For these reasons, our City has been selected for a "first-of-its-kind" pilot blue box collection project for flexible plastic film in North America.

This important research project will be carried out by the Environment and Plastics Institute of Canada (EPIC), Ministry of the Environment (MOE), the City of Peterborough, Scott's Plains Recycling Inc. and Proctor & Redfern Limited. Two Test Areas in the City have been selected for the pilot Blue Box collection program.

Your home is in one of the Test Areas selected.

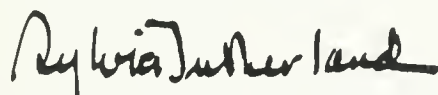
Beginning May 23, 1990, we will be asking you to place flexible plastic film in your Blue Box rather than in your regular garbage. The attached brochure explains more about the project and tells you exactly what kind of flexible plastic film to include in your Test Area.

The project will span a 26 week period, ending on November 16, 1990. During this time, we will be assessing the quality and quantity of flexible plastic film recovered, participation rates, time and labour required for collecting and processing the plastic, and the costs and benefits involved.

Your participation and support for this important research project will ensure its success. The results will help all communities that share the common goal of reducing the quantity of waste headed to rapidly filling landfills.

If you have any questions or comments regarding the pilot blue box collection project, please call Peter Gwyn at 876-1600 (Wednesday to Friday between 9:00 and 6:00) or Jay Stanford at 416-445-3600 (call collect, Monday and Tuesday between 9:00 and 6:00).

Yours very truly



Sylvia Sutherland

Mayor

City of Peterborough

WELCOME TO PETERBOROUGH'S

PILOT BLUE BOX COLLECTION

PROJECT FOR FLEXIBLE PLASTIC FILM

Your household is in a "Test Area" that has been carefully selected for the purpose of testing the feasibility of adding flexible plastic film to your Blue Box along with your other recyclable materials (newspaper, glass, steel and aluminum cans, plastic soft drink bottles). In fact, you are now a part of the first pilot project of its kind in North America. By adding flexible plastic film to the Blue Box, we are taking another step towards reducing the amount of waste going to landfill.

This six month project will begin on May 23, 1990 and end on November 16, 1990. To participate, three easy steps should be followed:

1. Collect your flexible plastic film in your home the same way you collect your other Blue Box materials (please clean dirty flexible plastic film as the contamination hinders the recycling process).
2. Place or 'stuff' your flexible plastic film into the same bag that you currently use for your newspaper (most Peterborough residents use this method) or simply place all your flexible plastic film into one bag and then into your Blue Box.
3. Place your full Blue Box at the curb as you normally do. We take over from there!

Peterborough has been selected to take part in this exciting pilot project because of the enthusiastic response of the residents towards the Blue Box recycling program and other waste management responsibilities. Two areas within Peterborough have been chosen for the pilot project, each with a different list of flexible plastic film to place in the Blue Box. Your household is included in Test Area 'A'.

This research project is sponsored by the Environment and Plastics Institute of Canada (EPIC) and the Ministry of the Environment, in conjunction with the City of Peterborough, Scott's Plains Recycling Inc. and Proctor & Redfern Limited. Information gathered from the pilot project will help communities across North America to divert more materials from landfill.

The inside pages of this brochure explain what kind of flexible plastic film to include in your Blue Box, and what not to include. Also enclosed is a handy reference card, with a magnet attached, to post on your refrigerator. The two plastic grocery bags included with this information plus the outer delivery bag are examples of the ability to reuse and recycle flexible plastic film.

If you have any questions or concerns, please come to our Information Session on May 8, 1990 (see attached invitation), or call Peter Gwyn at 876-1600 (Wednesday to Friday) or Jay Stanford at 416-445-3600 (call collect). We'll be glad to help.



PROJECT OVERVIEW

The purpose of this six month pilot collection program is to determine the feasibility of collecting flexible plastic film in the blue box program. To do this, we will be examining a number of important areas ranging from program participation and collection to processing and marketing the recovered material.

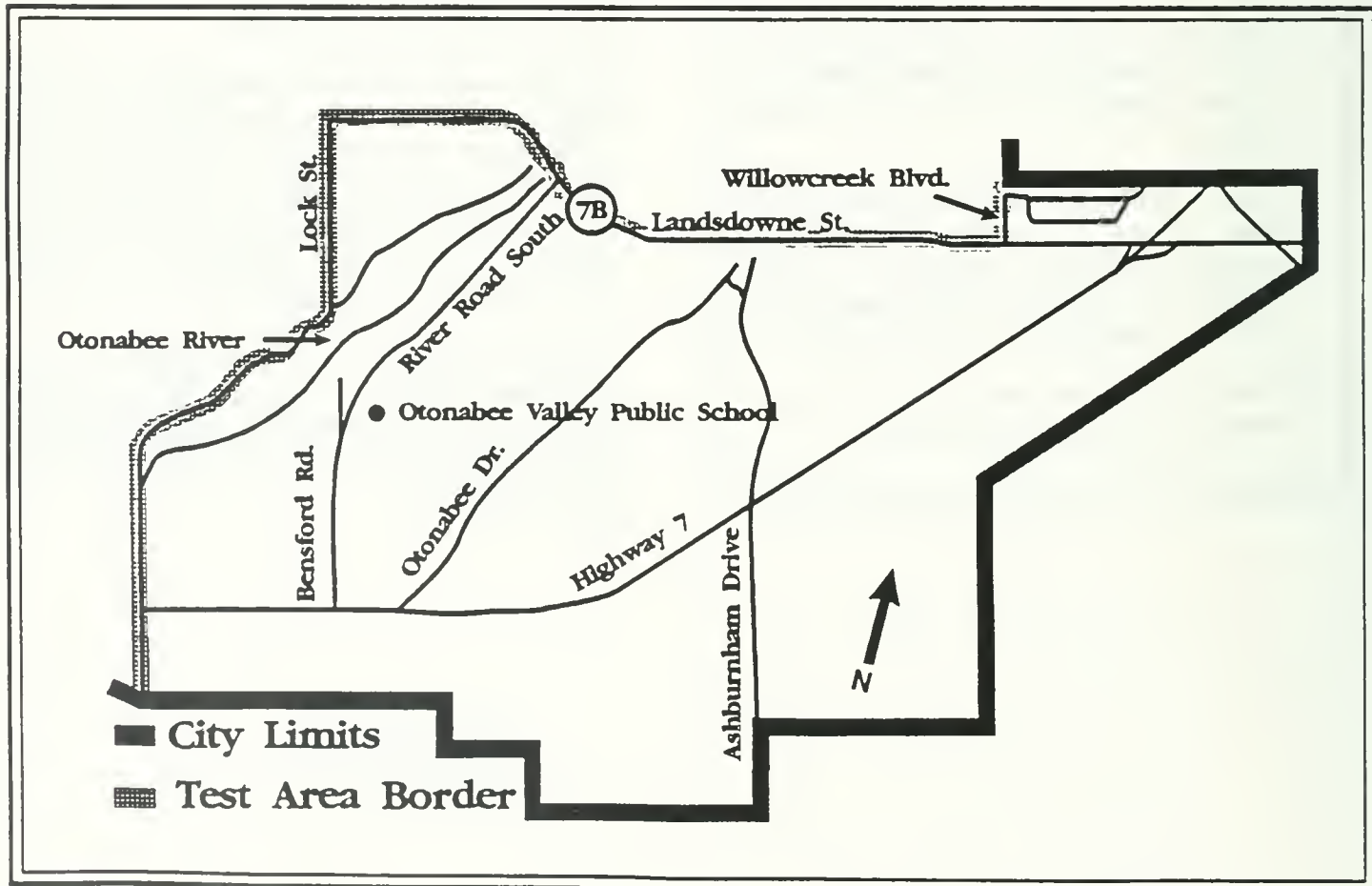
To determine program participation, we will be monitoring how many households are placing plastic films into their blue box. This will mean that you may occasionally see a person looking inside your blue box. If you do, feel free to ask him/her how the study is progressing.

The program will also examine various collection methods to determine the most appropriate method of adding this material to the current collection arrangement. This will include an evaluation and comparison of collection times, the amount of manual sorting performed at the truck, and the ease of adding flexible plastic film to the recycling program.

Most importantly, the collected flexible plastic film will be assessed in terms of quantity and quality to determine the suitability for recycling into new products. Discussions will also be held with potential retailers of products such as recycled plastic film or plastic lumber.

Test Area 'A'

Approximately 2,000 households are included in Test Area 'A'.



TEST AREA 'A'

WHAT TO INCLUDE

(in addition to your newspaper, glass, aluminum and steel cans, and plastic soft drink bottles)

YES!

Please place in your blue box:

- plastic grocery sacks (please remove cash register tapes)
- milk or other pouches (please rinse)
- milk outer bags
- bread bags, sandwich bags, bulk food bags
- dry cleaning bags
- diaper outer bags (absolutely no diapers)
- frozen vegetable (peas, corn, etc.) bags
- snack food (chips, pretzels, candy, nachos, etc.) bags
- plastic produce (apples, carrots, potatoes, etc.) bags
- plastic food overwrap (please wash, if dirty)
- plastic packaging for bacon, meats, etc. (please wash)
- plastic cereal and cracker liners
- overwrap from toilet tissue, paper towels, cigarettes
- plastic overwrap from boxes
- candy bags

Note: Please remove paper price stickers from packaging and ensure that the plastic is free of contamination, paper and food scraps.

WHAT NOT TO INCLUDE

NO!

Please do NOT put any of the following plastics in your blue box:

- rigid plastic containers (e.g. margarine tubs, yogurt containers, fruit juice bottles, motor oil bottles, cookie trays, etc.)
- semi-rigid plastic packaging such as six pack holders
- foam cups, egg cartons, meat trays
- toothpaste tubes and pumps
- rubber gloves or balloons
- any containers used for herbicides, pesticides and caustic cleaning compounds such as drain cleaner, oven cleaner, etc.

Remember if in doubt, leave it out!

A FEW WORDS ABOUT PLASTICS AND RECYCLING IN ONTARIO

Some Characteristics of the Plastics Industry

The plastics industry is one of Canada's fastest growing industrial sectors. Consumption of plastic resins has grown by an average of 8% a year since 1975, with almost 1.7 million tonnes consumed in 1986.

Although large, the industry is comprised of three primary industrial segments: manufacturers of plastic resins; manufacturers of equipment, moulds and related materials to convert resins into finished products; and the converters (plastic resins to finished products). Together they employ more than 90,000 people in Canada, also making the plastics industry one of Canada's largest employers.

Without plastics, many of the products that we have grown accustomed to, such as transparent milk pouches and shatterproof shampoo and detergent bottles, could not be economically manufactured. Further, a number of existing products have been redesigned to be more efficient, cleaner and less costly than is possible with glass, metals, paper or wood.

Plastics also save energy. Studies indicate that it takes less energy to manufacture a product from plastics than it does to make a similar product from glass, metal, paper or wood; even when the main constituents of plastic, oil and natural gas, are included. In fact, less than 2% of the oil and natural gas produced annually in Canada is used to manufacture plastic resins.

A number of terms are often used to differentiate household plastics products: rigid (milk jugs, soft drink bottles, bleach bottles), flexible film (grocery sacks, milk pouches, outer bags, etc.) durable (toys, car parts, etc.), and non-durable (fast food containers, etc.). While, durable plastic products are discarded by the householder over a period of years, rigid, flexible film and non-durable plastics are discarded more frequently.

All common plastics are inherently recyclable. In fact, they have been recycled in plastics manufacturing plants for decades by grinding plastic scrap into a pellet form that can be extruded into another product. Collecting and recycling "post consumer" plastic scrap (plastic products that have passed through their end use as a consumer item) is relatively new, however.

Rigid Plastic Containers and Bottles

The Environment and Plastics Institute of Canada (EPIC) saw the need to investigate the collection of rigid plastic containers and bottles from households.

In December of 1988, EPIC and the Ministry of the Environment (MOE) sponsored a demonstration collection project in Barrhaven, Ontario "to ascertain the added effort/equipment involved, the actual quantities collected, and the types of plastics in MSW (municipal solid waste) when rigid plastic containers are added to an existing BB (blue box) system. Data from this study would be of benefit to municipalities and recycling operators who are contemplating the extension of the range of materials in their BB system" (MOE, November 1989).

With the exception of the 2 litre plastic (PET) soft drink bottle, the recovery of other post consumer residential plastic for recycling in Ontario began in 1989. Metro Toronto has the largest curbside residential plastics collection program in North America, collecting specified rigid plastic containers and bottles in its blue box program. Guelph initiated collection of all rigid plastics in its blue box program, and Mississauga is collecting both rigid and film plastic through its blue box program.

As new information (e.g. curbside collection costs, collection methods, markets, etc.) becomes available from these and other city-wide projects, more and more communities will begin adding rigid plastic containers and bottles to their blue box programs.

Flexible Plastic Film Pilot Collection Project

Now we must have data on flexible plastic film to provide valuable information to North American communities, including your own, to determine the most effective and practical collection and recycling approaches.

We are purposely not including rigid plastic containers and bottles in this Pilot Collection Project so that data we obtain deals exclusively with flexible plastic film. For now, please continue to place your rigid plastic containers and bottles (except for your PET bottles) into your regular garbage.

WELCOME TO PETERBOROUGH'S

PILOT BLUE BOX COLLECTION

PROJECT FOR FLEXIBLE PLASTIC FILM

Your household is in a "Test Area" that has been carefully selected for the purpose of testing the feasibility of adding flexible plastic film to your Blue Box along with your other recyclable materials (newspaper, glass, steel and aluminum cans, plastic soft drink bottles). In fact, you are now a part of the first pilot project of its kind in North America. By adding flexible plastic film to the Blue Box, we are taking another step towards reducing the amount of waste going to landfill.

This six month project will begin on May 23, 1990 and end on November 16, 1990. To participate, three easy steps should be followed:

1. Collect your flexible plastic film in your home the same way you collect your other Blue Box materials (please clean dirty flexible plastic film as the contamination hinders the recycling process).
2. Place or 'stuff' your flexible plastic film into the same bag that you currently use for your newspaper (most Peterborough residents use this method) or simply place all your flexible plastic film into one bag and then into your Blue Box.
3. Place your full Blue Box at the curb as you normally do. We take over from there!

Peterborough has been selected to take part in this exciting pilot project because of the enthusiastic response of the residents towards the Blue Box recycling program and other waste management responsibilities. Two areas within Peterborough have been chosen for the pilot project, each with a different list of flexible plastic film to place in the Blue Box. Your household is included in Test Area 'B'.

This research project is sponsored by the Environment and Plastics Institute of Canada (EPIC) and the Ministry of the Environment, in conjunction with the City of Peterborough, Scott's Plains Recycling Inc. and Proctor & Redfern Limited. Information gathered from the pilot project will help communities across North America to divert more materials from landfill.

The inside pages of this brochure explain what kind of flexible plastic film to include in your Blue Box, and what not to include. Also enclosed is a handy reference card, with a magnet attached, to post on your refrigerator. The two plastic grocery bags included with this information plus the outer delivery bag are examples of the ability to reuse and recycle flexible plastic film.

If you have any questions or concerns, please come to our Information Session on May 10, 1990 (see attached invitation), or call Peter Gwyn at 876-1600 (Wednesday to Friday) or Jay Stanford at 416-445-3600 (call collect). We'll be glad to help.



PROJECT OVERVIEW

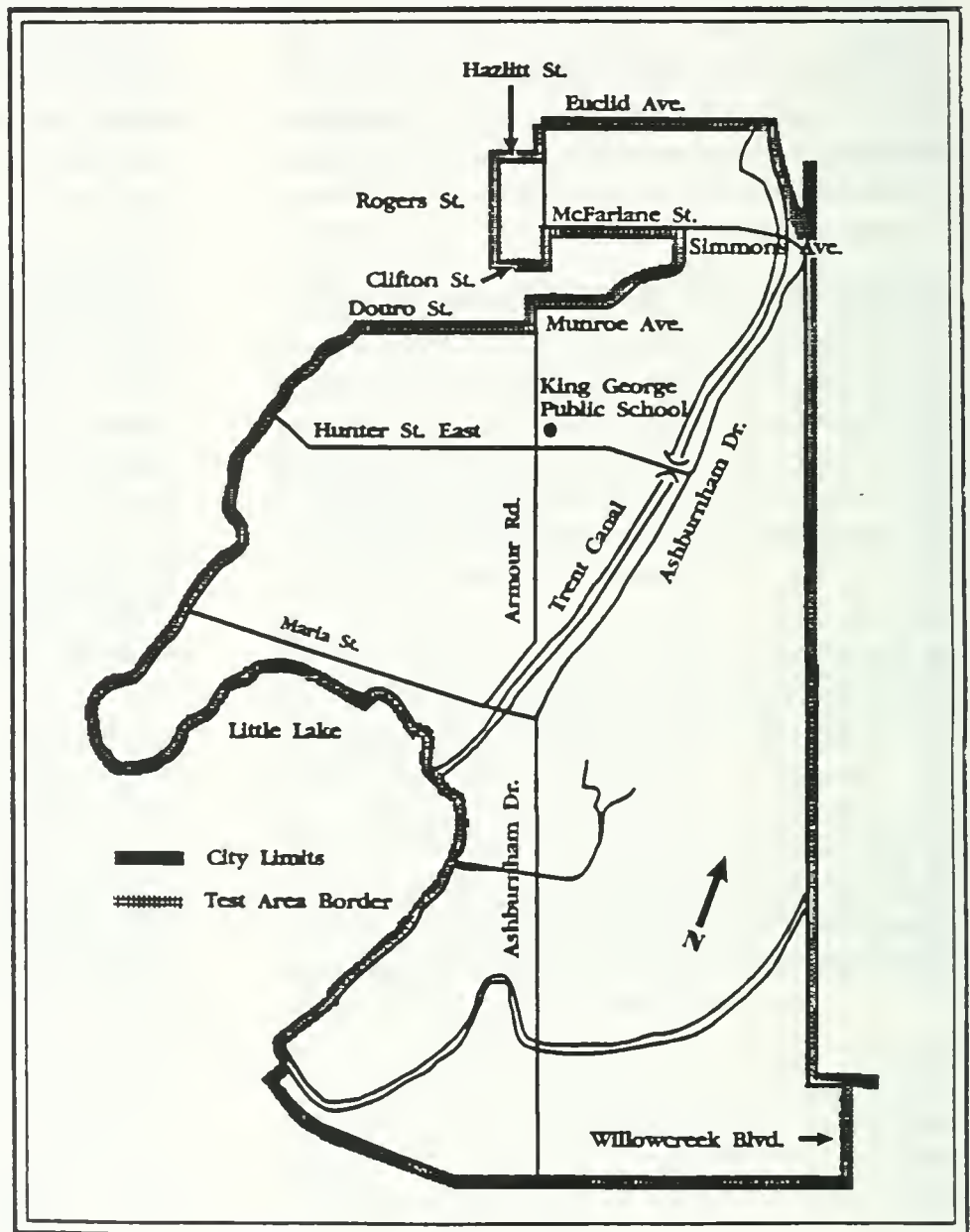
The purpose of this six month pilot collection program is to determine the feasibility of collecting flexible plastic film in the blue box program. To do this, we will be examining a number of important areas ranging from program participation and collection to processing and marketing the recovered material.

To determine program participation, we will be monitoring how many households are placing plastic films into their blue box. This will mean that you may occasionally see a person looking inside your blue box. If you do, feel free to ask him/her how the study is progressing.

The program will also examine various collection methods to determine the most appropriate method of adding this material to the current collection arrangement. This will include an evaluation and comparison of collection times, the amount of manual sorting performed at the truck, and the ease of adding flexible plastic film to the recycling program

Most importantly, the collected flexible plastic film will be assessed in

terms of quantity and quality to determine the suitability for recycling into new products. Discussions will also be held with potential retailers of products such as recycled plastic film or plastic lumber.



Test Area 'B'

Approximately 2,000 households are included in Test Area 'B'.

TEST AREA 'B'

WHAT TO INCLUDE

(in addition to your newspaper, glass, aluminum and steel cans, and plastic soft drink bottles)

YES!

Please place in your blue box:

- plastic grocery sacks (please remove cash register tapes)
- milk or other pouches (please rinse)
- milk outer bags
- bread bags, sandwich bags, bulk food bags
- dry cleaning bags
- diaper outer bags (absolutely no diapers)
- frozen vegetable (peas, corn, etc.) bags
- plastic produce (apples, carrots, potatoes, etc.) bags
- overwrap from toilet tissue, paper towels

Note: Please remove paper price stickers from packaging and ensure that the plastic is free of contamination, paper and food scraps.

WHAT NOT TO INCLUDE

NO!

Please do NOT put any of the following plastics in your blue box:

- plastic food wrap
- plastic cereal and cracker liners
- plastic overwrap from boxes
- snack food (eg. chips, pretzels, candy, nachos, etc.) bags
- rigid plastic containers (e.g. softdrink bottles, margarine tubs, yogurt containers, fruit juice bottles, motor oil bottles, cookie trays, etc.)
- foam cups, egg cartons, meat trays
- toothpaste tubes and pumps
- any containers used for herbicides, pesticides and caustic cleaning compounds such as drain cleaner, oven cleaner etc.
- rubber gloves or balloons

Remember if in doubt, leave it out!

A FEW WORDS ABOUT PLASTICS AND RECYCLING IN ONTARIO

Some Characteristics of the Plastics Industry

The plastics industry is one of Canada's fastest growing industrial sectors. Consumption of plastic resins has grown by an average of 8% a year since 1975, with almost 1.7 million tonnes consumed in 1986.

Although large, the industry is comprised of three primary industrial segments: manufacturers of plastic resins; manufacturers of equipment, moulds and related materials to convert resins into finished products; and the converters (plastic resins to finished products). Together they employ more than 90,000 people in Canada, also making the plastics industry one of Canada's largest employers.

Without plastics, many of the products that we have grown accustomed to, such as transparent milk pouches and shatterproof shampoo and detergent bottles, could not be economically manufactured. Further, a number of existing products have been redesigned to be more efficient, cleaner and less costly than is possible with glass, metals, paper or wood.

Plastics also save energy. Studies indicate that it takes less energy to manufacture a product from plastics than it does to make a similar product from glass, metal, paper or wood; even when the main constituents of plastic, oil and natural gas, are included. In fact, less than 2% of the oil and natural gas produced annually in Canada is used to manufacture plastic resins.

A number of terms are often used to differentiate household plastics products: rigid (milk jugs, soft drink bottles, bleach bottles), flexible film (grocery sacks, milk pouches, outer bags, etc.) durable (toys, car parts, etc.), and non-durable (fast food containers, etc.). While, durable plastic products are discarded by the householder over a period of years, rigid, flexible film and non-durable plastics are discarded more frequently.

All common plastics are inherently recyclable. In fact, they have been recycled in plastics manufacturing plants for decades by grinding plastic scrap into a pellet form that can be extruded into another product. Collecting and recycling "post consumer" plastic scrap (plastic products that have passed through their end use as a consumer item) is relatively new, however.

Rigid Plastic Containers and Bottles

The Environment and Plastics Institute of Canada (EPIC) saw the need to investigate the collection of rigid plastic containers and bottles from households.

In December of 1988, EPIC and the Ministry of the Environment (MOE) sponsored a demonstration collection project in Barrhaven, Ontario "to ascertain the added effort/equipment involved, the actual quantities collected, and the types of plastics in MSW (municipal solid waste) when rigid plastic containers are added to an existing BB (blue box) system. Data from this study would be of benefit to municipalities and recycling operators who are contemplating the extension of the range of materials in their BB system" (MOE, November 1989).

With the exception of the 2 litre plastic (PET) soft drink bottle, the recovery of other post consumer residential plastic for recycling in Ontario began in 1989. Metro Toronto has the largest curbside residential plastics collection program in North America, collecting specified rigid plastic containers and bottles in its blue box program. Guelph initiated collection of all rigid plastics in its blue box program, and Mississauga is collecting both rigid and film plastic through its blue box program.

As new information (e.g. curbside collection costs, collection methods, markets, etc.) becomes available from these and other city-wide projects, more and more communities will begin adding rigid plastic containers and bottles to their blue box programs.

Flexible Plastic Film Pilot Collection Project

Now we must have data on flexible plastic film to provide valuable information to North American communities, including your own, to determine the most effective and practical collection and recycling approaches.

We are purposely not including rigid plastic containers and bottles in this Pilot Collection Project so that data we obtain deals exclusively with flexible plastic film. For now, please continue to place your rigid plastic containers and bottles (except for your PET bottles) into your regular garbage.

PILOT BLUE BOX COLLECTION PROJECT **FOR** **FLEXIBLE PLASTIC FILM**

Thank you for your on-going participation!

TEST AREA 'A'

WHAT TO INCLUDE:

- plastic grocery sacks (please remove cash register tapes)
- milk or other pouches (please rinse)
- milk outer bags
- bread bags, sandwich bags, bulk food bags
- dry cleaning bags
- diaper outer bags (absolutely no diapers)
- frozen vegetable (peas, corn, etc.) bags
- snack food (chips, pretzels, candy, nachos, etc.) bags
- plastic produce (apples, carrots, potatoes, etc.) bags
- plastic food overwrap (please wash, if dirty)
- plastic packaging for bacon, meats, etc. (please wash)
- plastic cereal and cracker liners
- overwrap from toilet tissue, paper towels, cigarettes

Note: Please remove paper price stickers from packaging and ensure that the plastic is free of contamination, paper and food scraps.

REMEMBER IF IN DOUBT, LEAVE IT OUT!

Contains recycled fibre.

PILOT BLUE BOX COLLECTION PROJECT **FOR** **FLEXIBLE PLASTIC FILM**

Thank you for your on-going participation!

TEST AREA 'B'

WHAT TO INCLUDE:

- plastic grocery sacks (please remove cash register tapes)
- milk or other pouches (please rinse)
- milk outer bags
- bread bags, sandwich bags, bulk food bags
- dry cleaning bags
- diaper outer bags (absolutely no diapers)
- frozen vegetable (peas, corn, etc.) bags
- plastic produce (apples, carrots, potatoes, etc.) bags
- overwrap from toilet tissue, paper towels

Note: Please remove paper price stickers from packaging and ensure that the plastic is free of contamination, paper and food scraps.

REMEMBER IF IN DOUBT, LEAVE IT OUT!

Contains recycled fibre.

PILOT BLUE BOX COLLECTION PROJECT

FOR FLEXIBLE PLASTIC FILM

You are cordially invited to attend an

INFORMATION SESSION

ON MAY 10TH, 1990

AT KING GEORGE PUBLIC SCHOOL

(corner of Armour Street and Hunter Street East)

FROM 6 TO 9 P.M.

**. to ask questions and to offer your valued insight into
this "first-of-its-kind" pilot project in North America.**

Representatives from the Environment and Plastics Institute of Canada (EPIC), the City of Peterborough, Scott's Plains Recycling Inc. and Proctor & Redfern Limited will be present to describe the project and answer any questions. Questions and comments received will be summarized in a future project update, to be distributed to the Test Area residents.

Refreshments will be served!

FREE DRAW FOR A BACKYARD COMPOSTER!

Complete the information below and deposit this entire page in the ballot box to be eligible for a backyard composting unit.

Name: _____

Address: _____

_____ Telephone _____

(The winner will be notified before May 23, 1990)

APPENDIX E

ON-GOING PUBLIC EDUCATION AND PROMOTIONAL ACTIVITIES

FLEXIBLE PLASTIC FILM PILOT PROJECT UPDATE

YOU ASKED, WE ANSWERED

Many excellent questions were asked at the Information Sessions, at which representatives from the Environment and Plastics Institute of Canada (EPIC), the Ministry of the Environment (MOE), the City of Peterborough, Scott's Plains Recycling Inc. and Proctor & Redfern, ("the project team") were in attendance. The following answers address the concerns raised at these sessions, and will be particularly helpful to those who could not attend.

What is meant by 'flexible plastic film'?

Flexible plastic film is the term used to encompass plastic products such as plastic bags and plastic wraps. Although some rigid and semi-rigid plastic packaging is somewhat flexible, flexible plastic film refers only to materials such as plastic grocery sacks, milk pouches and the other items included on your 'Yes' list.

Why only limited areas in the City of Peterborough?

The project is designed to determine the feasibility of collecting flexible plastic film in the blue box. To do this, we have limited the pilot project to two Test Areas that represent a cross-section of the entire city. This will allow the project team to conduct a number of individual studies such as evaluating program participation and ease of material separation at the Recycling Centre.

How does the project work?

Just a reminder on how to participate: simply place your flexible plastic film in the same plastic bag as your newspaper, or in a separate plastic bag if you wish, and then place all flexible plastic film into your blue box along with the usual recyclable materials. When the blue box becomes full, place it at the curb on the regular collection day. Once the flexible plastic film has been collected and unloaded at Scott's Plains Recycling Centre, it is separated by type and weighed.

What kind of plastics are being collected?

Only flexible plastic film is being collected in this pilot study. Test Area 'A' and Test Area 'B' have separate lists of acceptable types of flexible plastic film to include in the blue box. Test Area 'A' includes mixed flexible plastic film (e.g. low density polyethylene bags, laminated film such as candy bags, etc), while Test Area 'B' includes predominately low density polyethylene plastic bags.

To date, participation and enthusiasm for the project have been fantastic! However, some plastics have been collected that are NOT considered flexible plastic film. These include such items as:

- rigid plastic containers for bleach and vegetable oil,
- blister packaging, e.g. packaging around batteries
- cookie and pastry trays, tomato trays
- six-pack beverage rings
- nylon bands
- foam containers
- ice cream and yoghurt tubs

Although rigid plastic containers can be recycled, they are not included in this particular project, with the exception of the 2 litre soft drink bottles currently collected in the blue box program. A similar research project was undertaken in Barrhaven, Ontario which dealt with rigid plastic materials.

**The handout listed grocery sacks to be included.
What about other plastic bags?**

Please include all your plastic bags from all types of stores. Just mentioning grocery sacks was an oversight on our part.

How clean do the flexible plastic films have to be?

We would appreciate you rinsing milk pouches and shaking crumbs out of bread bags. Also, food scraps, grease, etc. must be removed by washing with warm water and soap. Removing price stickers and sales receipts is also important. However most importantly, we want you to establish the effort of cleaning with which you feel comfortable and which will encourage your continuing participation in the pilot project.

Can I include plastic from friends and relatives outside my Test Area?

Although it is great to see such enthusiasm for Peterborough's recycling and waste diversion programs, you must only include your own flexible plastic film in the blue box. The reason for this is that part of the purpose of the study is to determine how much plastic flexible film is generated per household in each Test Area.

What will happen to the plastics that are collected?

Flexible plastic film collected during the pilot program will be shown to potential processors of post-consumer flexible plastic film to determine its suitability for recycling. As well, discussions with retailers of recycled plastic products will be held to determine demand for such items.

Who is paying for the research project?

The project is being jointly funded by the Environment and Plastics Institute of Canada (EPIC) and the Ministry of the Environment (MOE). The City of Peterborough and Scott's Plains Recycling Inc. are contributing indirectly to the project, in that the

project will use the collection/processing staff, recycling trucks and Recycling Centre currently involved in the blue box program.

What is the Environment and Plastics Institute of Canada (EPIC), and why is it supporting this project?

EPIC was formed by The Society of the Plastics Industry of Canada (SPI) to focus primarily on issues involved with the management of plastics in the environment throughout Canada. This includes fostering effective, responsible solutions regarding the management of plastic waste.

What is Proctor & Redfern's involvement in this project?

Proctor & Redfern has been retained by EPIC and MOE to manage the project and coordinate all study activities.

How long will the project last?

The pilot collection program will run from Wednesday, May 23, 1990 to Friday, November 16, 1990.

Who can I contact if I have questions regarding the program or about specific kinds of plastics during the next six months?

Please call Peter Gwyn at the Scott's Plains Recycling Centre (876-1600) during business hours from Wednesday to Friday with any questions or concerns. If not available, call Jay Stanford or Patty Quackenbush at 416-445-3600 (call collect). We'll be glad to help.

Congratulations to the winners of the backyard composting units:

Test Area "A" - Dorothy Whitney

Test Area "B" - George Axcell

FLEXIBLE PLASTIC FILM PILOT PROJECT

UPDATE #2

This is a friendly reminder that the flexible plastic film project is still underway. Your continuing support of our pilot project is important in determining the feasibility of collecting flexible plastic film in the blue box program.

PRELIMINARY RESULTS

The project team is very excited about the results to date. On average, 50 grams of flexible plastic film is collected per household per week, which is the equivalent of about 5 grocery sacks. The overall quality of the material has been good, with contamination from materials such as rigid plastic containers and other non-plastic items averaging about 5 per cent. A preliminary look at the collected materials indicates that the flexible plastic film is fairly clean (e.g. free of food residue, price stickers). The exact quantity of this type of contamination is being further investigated in a study being carried out at the present time.

KEY STUDIES

Now that most people have returned from summer vacations, and are back into their regular routines, we will be implementing a number of key studies to examine various activities relating to the project. Two of these studies will begin in September:

Participation Analysis - we will be monitoring how many households are placing flexible plastic film into their blue box and the frequency at which they set it at the curb. (Remember, you should put your blue box out only when it is full.)

Capture Rate Analysis - the quantity of flexible plastic film placed in the blue box will be compared to the quantity that is generated in the home to determine what percentage is "captured" by the householder. To do this, thirty households will be randomly selected for this study. The quantity of garbage, blue box materials and flexible plastic film placed at the curb by these householders will be removed and weighed.

In recognition of the interest and enthusiasm Test Area residents have shown for this project, we are providing you with a chance to win a:

— FREE DINNER FOR TWO —

One household in each Test Area will be randomly selected and telephoned. Upon correctly answering a question which tests their knowledge about the contents of this update, the resident will win a free dinner for two (value \$50.00) at a Peterborough restaurant.

We look forward to your continued, or perhaps new, participation in this program, which ends on November 16, 1990. For your convenience, the Yes/No list for your Test Area has been repeated on the other side of this Update.

If you have any questions or concerns, call Peter Gwyn at 876-1600 (Wednesday to Friday) or Jay Stanford at 416-445-3600 (call collect). We'll be glad to help.

FLEXIBLE PLASTIC FILM PILOT PROJECT – FINAL NOTICE

TEST AREA A

Thank you for your enthusiastic support of Peterborough's flexible plastic film pilot project over the past six months.

The study team has now completed the data collection phase of the pilot study and it has been determined that collection of flexible plastic film will continue in the Test Areas for another six months. The City of Peterborough will use the pilot study results and any new information gathered during the next six months to decide whether or

not to expand the collection program to other areas of the city.

For the next six months, we are asking the residents of Test Area 'A' to adjust the list of products which they currently place in the blue box. Therefore, we are asking Test Area 'A' residents to discard their previous YES/NO lists and magnetic fridge cards, and refer to the new list on the reverse side of this notice.

Our results indicate that the best way to participate is as follows:

1. Collect your flexible plastic film in your home the same way you collect your other blue box materials (please clean dirty flexible plastic film as the contamination hinders the recycling process).
2. Place or 'stuff' your flexible plastic film into a bag and then into the same bag that you currently use for your newspaper or simply place all your flexible plastic film into one bag and then into your blue box. Please do not tie the bag in which you place your newspaper. It is easier to separate the plastic bag from the newspaper at Scott's Plains if the bag is not tied. Please do not place your cans or glass containers in bags.
3. Place your full blue box at the curb as you normally do.

For further information, please call Scott's Plains Recycling at 876-1600.

FLEXIBLE PLASTIC FILM

PILOT PROJECT — FINAL NOTICE

TEST AREA B

Thank you for your enthusiastic support of Peterborough's flexible plastic film pilot project over the past six months.

The study team has now completed the data collection phase of the pilot study and it has been determined that collection of flexible plastic film will continue in the Test Areas for another six months. The City of Peterborough will use the pilot study results and any new information gathered during

the next six months to decide whether or not to expand the collection program to other areas of the city.

Please continue collecting flexible plastic film as you have to date. A YES/NO list is provided on the reverse side of this notice as a reminder of which types of flexible plastic film can be placed in your blue box and which types not to include.

Our results indicate that the best way to participate is as follows:

1. Collect your flexible plastic film in your home the same way you collect your other blue box materials (please clean dirty flexible plastic film as the contamination hinders the recycling process).
2. Place or 'stuff' your flexible plastic film into a bag and then into the same bag that you currently use for your newspaper or simply place all your flexible plastic film into one bag and then into your blue box. Please do not tie the bag in which you place your newspaper. It is easier to separate the plastic bag from the newspaper at Scott's Plains if the bag is not tied. Please do not place your cans or glass containers in bags.
3. Place your full blue box at the curb as you normally do.

For further information, please call Scott's Plains Recycling at 876-1600.

APPENDIX F

SURVEY RESULTS

F.1 Summary of Responses Test Area A - Type I Participant

Test Area: A
 Participation Type: Type I - Extra Plastic Bags and Film
 Number of Respondents: 63

Questions:

Responses:

A General Blue Box Recycling

1.	Do you participate in Peterborough's blue box program?	Yes	100%
		No	0%
2.	(a) How often do you place your blue box at the curb?	every week	70%
		every second week	25%
		every third week	2%
		once a month	3%
		less often	0%
	(b) Is it full when you put it out?	Yes	83%
		No	17%
3.	Do you take time to prepare materials for the blue box such as washing out cans?	Yes	100%
		No	0%
4.	(a) Do you feel that it is necessary to receive blue box - recycling information on a regular basis?	Yes	93%
		No	7%
	(b) In the past, in what forms have you received blue box education and promotion information?	T.V.	10%
		Radio	5%
		Newspaper	78%
		Notices in blue box	30%
		Door hangers	2%
		Mobile display booth	0%
		Permanent display booth	0%
	(c) In what form would blue box education and promotion information be most beneficial to you?	T.V.	3%
		Radio	3%
		Newspaper	33%
		Notices in blue box	10%
		Door hangers	0%
		Mobile display booth	0%
		Permanent display booth	0%
		Mail	87%
		Phone	8%

5.	(a) Do you place newspapers at the curb on blue box collection day?	Yes	98%
		No	2%
	(b) Do you put newspapers in a plastic bag and then into your blue box?	Yes	89%
		No	11%
	(c) Did you use this method before the pilot project?	Yes	86%
		No	14%
	(d) If 5b=No, what method do you now use for newspapers?	paper bag	3%
		bundle with string	2%
		loose	3%
6.	Do you place additional plastic bags and other plastic film in your blue box?	Yes	100%
		No	0%
B Pilot Project - Extra Plastic Bags and Film			
7.	Did you attend the public information centre held at the beginning of the pilot project?	Yes	5%
		No	95%
8.	Did you find the Project Announcement and Project Update material informative/useful?	Yes	100%
		No	0%
9.	Is your fridge magnet provided at the beginning of the pilot project still on your fridge?	Yes	83%
		No	17%
10.	(a) Would you like to have received more information door-to-door about the pilot project during its 6 month duration?	Yes	3%
		No	97%
	(b) What other methods of delivering pilot project information would have been beneficial to you?	T.V.	0%
		Radio	0%
		Newspaper	0%
		Notices in blue box	2%
		Door hangers	0%
		Mobile display booth	0%
		Permanent display booth	0%
11.	Do you find that it requires more effort to clean plastic film than your other recyclable materials?	Yes	35%
		No	65%
12.	Do you avoid placing plastic bags and plastic film into your blue box because it is too contaminated with such items as grease and blood residue?	Yes	78%
		No	22%

13.	Since the pilot project began, do you find that you place your blue box at the curb more frequently?	Yes	10%
		No	90%
14.	Do you reuse plastic bags in your home for such uses as freezing food or packing lunches?	Yes	83%
		No	17%
15.	Do you buy plastic bags for such uses as freezing food or packing lunches?	Yes	63%
		No	37%
16.	Do you reuse plastic bags to line waste baskets?	Yes	81%
		No	19%
17.	Do you buy plastic bags to line waste baskets?	Yes	37%
		No	63%
18.	(a) Do you reuse plastic grocery sacks at the grocery store?	Yes	37%
	(b) Do you use a reusable (nylon or fabric) bag at the grocery store?	No	63%
		Yes	33%
		No	67%
19.	(a) Have you ever used the bag bin at the local grocery stores (Food City, A&P)?	Yes	6%
		No	94%
	(b) If Yes, did you stop using it when the Pilot project began?	Yes	5%
		No	1%
20.	Would you like to continue placing plastic bags and film into your blue box?	Yes	100%
		No	0%
21.	What other materials would you like to see added to the blue box? (list)		
	Rigid plastics	50%	
	OCC	21%	

F.2 Summary of Responses for Test Area B - Type I Participant

Test Area: B
 Participation Type: Type I - Extra Plastic Bags and Film
 Number of Respondents: 70

Questions:

Responses:

A General Blue Box Recycling

1.	Do you participate in Peterborough's blue box program?	Yes	100%
		No	0%
2.	(a) How often do you place your blue box at the curb?	every week	71%
		every second week	23%
		every third week	1%
		once a month	4%
		less often	0%
	(b) Is it full when you put it out?	Yes	90%
		No	10%
3.	Do you take time to prepare materials for the blue box such as washing out cans?	Yes	96%
		No	4%
4.	(a) Do you feel that it is necessary to receive blue box recycling information on a regular basis?	Yes	3%
		No	97%
	(b) In the past, in what forms have you received blue box education and promotion information?	T.V.	3%
		Radio	21%
		Newspaper	84%
		Notices in blue box	17%
		Door hangers	0%
		Mobile display booth	0%
		Permanent display booth	0%
	(c) In what form would blue box education and promotion information be most beneficial to you?	T.V.	1%
		Radio	3%
		Newspaper	40%
		Notices in blue box	6%
		Door hangers	0%
		Mobile display booth	0%
		Permanent display booth	0%
		Mail	86%
		Phone	7%

5.	(a) Do you place newspapers at the curb on blue box collection day?	Yes	100%
		No	0%
	(b) Do you put newspapers in a plastic bag and then into your blue box?	Yes	93%
		No	7%
	(c) Did you use this method before the pilot project?	Yes	91%
		No	9%
	(d) If 5b=No, what method do you now use for newspapers?	paper bag	0%
		bundle with string	3%
		loose	4%
6.	Do you place additional plastic bags and other plastic film in your blue box?	Yes	100%
		No	0%
B Pilot Project - Extra Plastic Bags and Film			
7.	Did you attend the public information centre held at the beginning of the pilot project?	Yes	0%
		No	100%
8.	Did you find the Project Announcement and Project Update material informative/useful?	Yes	97%
		No	3%
9.	Is your fridge magnet provided at the beginning of the pilot project still on your fridge?	Yes	81%
		No	19%
10.	(a) Would you like to have received more information door-to-door about the pilot project during its 6 month duration?	Yes	0%
		No	100%
	(b) What other methods of delivering pilot project information would have been beneficial to you?	T.V.	0%
		Radio	0%
		Newspaper	0%
		Notices in blue box	0%
		Door hangers	0%
		Mobile display booth	0%
		Permanent display booth	0%
11.	Do you find that it requires more effort to clean plastic film than your other recyclable materials?	Yes	29%
		No	71%
12.	Do you avoid placing plastic bags and plastic film into your blue box because it is too contaminated with such items as grease and blood residue?	Yes	83%
		No	17%

13.	Since the pilot project began, do you find that you place your blue box at the curb more frequently?	Yes	3%
		No	97%
14.	Do you reuse plastic bags in your home for such uses as freezing food or packing lunches?	Yes	87%
		No	13%
15.	Do you buy plastic bags for such uses as freezing food or packing lunches?	Yes	56%
		No	44%
16.	Do you reuse plastic bags to line waste baskets?	Yes	89%
		No	11%
17.	Do you buy plastic bags to line waste baskets?	Yes	20%
		No	80%
18.	(a) Do you reuse plastic grocery sacks at the grocery store?	Yes	50%
	(b) Do you use a reusable (nylon or fabric) bag at the grocery store?	No	50%
		Yes	23%
		No	77%
19.	(a) Have you ever used the bag bin at the local grocery stores (Food City, A&P)?	Yes	1%
		No	99%
	(b) If Yes, did you stop using it when the Pilot project began?	Yes	1%
		No	0%
20.	Would you like to continue placing plastic bags and film into your blue box?	Yes	100%
		No	0%
21.	What other materials would you like to see added to the blue box? (list)		
	Rigid plastics	27%	
	OCC	21%	
	Magazines	9%	

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F.3 Summary of Responses for Test Area A - Type II Participant

Test Area: A
 Participation Type: Type II - Bagged Newspaper - No Extra Film
 Number of Respondents: 34

Questions:

Responses:

A General Blue Box Recycling

1.	Do you participate in Peterborough's blue box program?	Yes	100%
		No	0%
2.	(a) How often do you place your blue box at the curb?	every week	65%
		every second week	21%
		every third week	12%
		once a month	3%
		less often	0%
	(b) Is it full when you put it out?	Yes	82%
		No	18%
3.	Do you take time to prepare materials for the blue box such as washing out cans?	Yes	94%
		No	6%
4.	(a) Do you feel that it is necessary to receive blue box recycling information on a regular basis?	Yes	0%
		No	100%
	(b) In the past, in what forms have you received blue box education and promotion information?	T.V.	29%
		Radio	0%
		Newspaper	88%
		Notices in blue box	21%
		Door hangers	0%
		Mobile display booth	0%
		Permanent display booth	0%
	(c) In what form would blue box education and promotion information be most beneficial to you?	T.V.	6%
		Radio	6%
		Newspaper	41%
		Notices in blue box	9%
		Door hangers	0%
		Mobile display booth	3%
		Permanent display booth	0%
			62%
			9%

5.	(a) Do you place newspapers at the curb on blue box collection day?	Yes	100%
		No	0%
	(b) Do you put newspapers in a plastic bag and then into your blue box?	Yes	88%
		No	12%
	(c) Did you use this method before the pilot project?	Yes	85%
		No	15%
	(d) If 5b=No, what method do you now use for newspapers?	paper bag	0%
		bundle with string	3%
		loose	12%
6.	Do you place additional plastic bags and other plastic film in your blue box?	Yes	0%
		No	100%
C Bagged Newspaper - No Extra Film			
7.	•• What are your reasons for not placing additional plastic bags and plastic film into your blue box?		
	inconvenient or time consuming		32%
	do not throw out plastic bags and film		24%
	was not aware of the pilot project		32%
	did not understand purpose of the pilot project		6%
	information provided not clear		0%
	other		24%
8.	Did you attend the public information centre held at the beginning of the pilot project?	Yes	0%
		No	100%
9.	Did you find the Project Announcement and Project Update material informative/useful?	Yes	47%
		No	53%
10.	Is your fridge magnet provided at the beginning of the pilot project still on your fridge?	Yes	0%
		No	100%
11.	(a) Would you like to have received more information door-to-door about the pilot project during its 6 month duration?	Yes	0%
		No	100%
	(b) What other methods of delivering pilot project information would have been beneficial to you?	T.V.	0%
		Radio	0%
		Newspaper	0%
		Notices in blue box	6%
		Door hangers	3%
		Mobile display booth	0%

12. Do you reuse plastic bags in your home for such uses as freezing food or packing lunches?	Yes	79%
	No	21%
13. Do you buy plastic bags for such uses as freezing food or packing lunches?	Yes	56%
	No	44%
14. Do you reuse plastic bags to line waste baskets?	Yes	85%
	No	15%
15. Do you buy plastic bags to line waste baskets?	Yes	41%
	No	59%
16. (a) Do you reuse plastic grocery sacks at the grocery store? (b) Do you use a reusable (nylon or fabric) bag at the grocery store?	Yes	24%
	No	76%
	Yes	15%
	No	85%
17. (a) Have you ever used the bag bin at the local grocery stores (Food City, A&P)?	Yes	0%
	No	100%
18. What other materials would you like to see added to the blue box? (list)		
Rigid plastics	24%	
OCC	9%	

F.4 Summary of Responses for Test Area B - Type II Participant

Test Area: B
 Participation Type: Type II - Bagged Newspaper - No Extra Film
 Number of Respondents: 24

Questions:

Responses:

A General Blue Box Recycling

1.	Do you participate in Peterborough's blue box program?	Yes	100%
		No	0%
2.	(a) How often do you place your blue box at the curb?	every week	46%
		every second week	54%
		every third week	0%
	once a month 0% less often 0%	(b) Is it full when you put it out?	Yes 67%
		No	33%
3.	Do you take time to prepare materials for the blue box such as washing out cans?	Yes	92%
		No	8%
4.	(a) Do you feel that it is necessary to receive blue box recycling information on a regular basis?	Yes	0%
		No	100%
	(b) In the past, in what forms have you received blue box education and promotion information?	T.V.	41%
		Radio	8%
		Newspaper	58%
		Notices in blue box	42%
		Door hangers	0%
		Mobile display booth	0%
		Permanent display booth	0%
	(c) In what form would blue box education and promotion information be most beneficial to you?	T.V.	8%
		Radio	4%
		Newspaper	33%
		Notices in blue box	17%
		Door hangers	0%
		Mobile display booth	0%
		Permanent display booth	0%
		Mail	79%
		Phone	4%

5.	(a) Do you place newspapers at the curb on blue box collection day?	Yes	96%
		No	4%
	(b) Do you put newspapers in a plastic bag and then into your blue box?	Yes	88%
		No	12%
	(c) Did you use this method before the pilot project?	Yes	83%
		No	17%
	(d) If 5b=No, what method do you now use for newspapers?	paper bag	0%
		bundle with string	0%
		loose	8%
6.	Do you place additional plastic bags and other plastic film in your blue box?	Yes	4%
		No	96%
C Bagged Newspaper - No Extra Film			
7.	** What are your reasons for not placing additional plastic bags and plastic film into your blue box?		
	inconvenient or time consuming		29%
	do not throw out plastic bags and film		21%
	was not aware of the pilot project		54%
	did not understand purpose of the pilot project		4%
	information provided not clear		8%
	other:		29%
8.	Did you attend the public information centre held at the beginning of the pilot project?	Yes	0%
		No	100%
9.	Did you find the Project Announcement and Project Update material informative/useful?	Yes	21%
		No	79%
10.	Is your fridge magnet provided at the beginning of the pilot project still on your fridge?	Yes	4%
		No	96%
11.	(a) Would you like to have received more information door-to-door about the pilot project during its 6 month duration?	Yes	8%
		No	92%
	(b) What other methods of delivering pilot project information would have been beneficial to you?	T.V.	0%
		Radio	0%
		Newspaper	0%
		Notices in blue box	0%
		Door hangers	0%
		Mobile display booth	0%

12. Do you reuse plastic bags in your home for such uses as freezing food or packing lunches?	Yes	63%
	No	37%
13. Do you buy plastic bags for such uses as freezing food or packing lunches?	Yes	54%
	No	46%
14. Do you reuse plastic bags to line waste baskets?	Yes	83%
	No	17%
15. Do you buy plastic bags to line waste baskets?	Yes	46%
	No	54%
16. (a) Do you reuse plastic grocery sacks at the grocery store? (b) Do you use a reusable (nylon or fabric) bag at the grocery store?	Yes	17%
	No	83%
	Yes	4%
	No	96%
17. (a) Have you ever used the bag bin at the local grocery stores (Food City, A&P)?	Yes	0%
	No	100%
18. What other materials would you like to see added to the blue box? (list)		
Rigid plastics	16%	
OCC	8%	

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F.5 Summary of Responses for Test Area A - Non-participant

Test Area: A
 Participation Type: Non-participant
 Number of Respondents: 3

Questions:

Responses:

A General Blue Box Recycling

1.	Do you participate in Peterborough's blue box program?	Yes	100%
		No	0%
2.	(a) How often do you place your blue box at the curb?	every week	67%
		every second week	33%
		every third week	0%
		once a month	0%
		less often	0%
	(b) Is it full when you put it out?	Yes	100%
		No	0%
3.	Do you take time to prepare materials for the blue box such as washing out cans?	Yes	100%
		No	0%
4.	(a) Do you feel that it is necessary to receive blue box recycling information on a regular basis?	Yes	0%
		No	100%
	(b) In the past, in what forms have you received blue box education and promotion information?	T.V.	0%
		Radio	0%
		Newspaper	33%
		Notices in blue box	33%
		Door hangers	0%
		Mobile display booth	0%
		Permanent display booth	0%
	(c) In what form would blue box education and promotion information be most beneficial to you?	T.V.	0%
		Radio	0%
		Newspaper	0%
		Notices in blue box	33%
		Door hangers	0%
		Mobile display booth	0%
		Permanent display booth	0%
		Mail	0%
		Phone	0%

5.	(a) Do you place newspapers at the curb on blue box collection day?	Yes	67%
		No	33%
	(b) Do you put newspapers in a plastic bag and then into your blue box?	Yes	0%
		No	100%
	(c) Did you use this method before the pilot project?	Yes	0%
		No	100%
(d) If 5b=No, what method do you now use for newspapers?			
	paper bag		0%
	bundle with string		0%
	loose		33%
6.	Do you place additional plastic bags and other plastic film in your blue box?	Yes	0%
		No	100%
D Non-Participants in Pilot Project			
7.	What are your reasons for not participating?		
	inconvenient or time consuming		0%
	do not throw out plastic bags and film		0%
	was not aware of the pilot project		0%
	did not understand purpose of the pilot project		0%
	information provided not clear		67%
	other:		
8.	Do you reuse plastic bags in your home for such uses as freezing food or packing lunches?	Yes	67%
		No	33%
9.	Do you buy plastic bags for such uses as freezing food or packing lunches?	Yes	67%
		No	33%
10.	Do you use plastic bags to line wastebaskets?	Yes	67%
		No	33%
11.	Do you buy plastic bags to line waste baskets?	Yes	33%
		No	67%
12.	(a) Do you reuse plastic grocery sacks at the grocery store?	Yes	0%
	(b) Do you use a reusable (nylon or fabric) bag at the grocery store?	No	100%
		Yes	0%
		No	100%
13.	Do you ever use the bag bin at the local grocery stores (Food City, A&P)?	Yes	0%
		No	100%

14. What other materials would you like to see added to the blue box?
(list)

Rigid Plastics 33%

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F.6 Summary of Responses for Test Area B - Non-participant

Test Area: B
 Participation Type: Non-participant
 Number of Respondents: 6

Questions:

Responses:

A General Blue Box Recycling

1.	Do you participate in Peterborough's blue box program?	Yes	100%
		No	0%
2.	(a) How often do you place your blue box at the curb?	every week	83%
		every second week	17%
		every third week	0%
		once a month	0%
		less often	0%
	(b) Is it full when you put it out?	Yes	100%
		No	0%
3.	Do you take time to prepare materials for the blue box such as washing out cans?	Yes	83%
		No	17%
4.	(a) Do you feel that it is necessary to receive blue box recycling information on a regular basis?	Yes	0%
		No	100%
	(b) In the past, in what forms have you received blue box education and promotion information?	T.V.	33%
		Radio	0%
		Newspaper	83%
		Notices in blue box	33%
		Door hangers	0%
		Mobile display booth	0%
		Permanent display booth	0%
	(c) In what form would blue box education and promotion information be most beneficial to you?	T.V.	0%
		Radio	0%
		Newspaper	0%
		Notices in blue box	0%
		Door hangers	0%
		Mobile display booth	0%
		Permanent display booth	0%
		Mail	100%
		Phone	0%

5.	(a) Do you place newspapers at the curb on blue box collection day?	Yes	33%
		No	67%
	(b) Do you put newspapers in a plastic bag and then into your blue box?	Yes	0%
		No	100%
	(c) Did you use this method before the pilot project?	Yes	0%
		No	100%
	(d) If 5b=No, what method do you now use for newspapers?	paper bag	17%
		bundle with string	0%
		loose	17%
6.	Do you place additional plastic bags and other plastic film in your blue box?	Yes	0%
		No	100%
D Non-Participants in Pilot Project			
7.	What are your reasons for not participating?		
	inconvenient or time consuming		0%
	do not throw out plastic bags and film		33%
	was not aware of the pilot project		67%
	did not understand purpose of the pilot project		0%
	information provided not clear		0%
	other:		33%
8.	Do you reuse plastic bags in your home for such uses as freezing food or packing lunches?	Yes	67%
		No	33%
9.	Do you buy plastic bags for such uses as freezing food or packing lunches?	Yes	50%
		No	50%
10.	Do you use plastic bags to line wastebaskets?	Yes	100%
		No	0%
11.	Do you buy plastic bags to line waste baskets?	Yes	17%
		No	83%
12.	(a) Do you reuse plastic grocery sacks at the grocery store?	Yes	17%
	(b) Do you use a reusable (nylon or fabric) bag at the grocery store?	No	83%
		Yes	0%
		No	100%
13.	Do you ever use the bag bin at the local grocery stores (Food City, A&P)?	Yes	0%
		No	100%

14. What other materials would you like to see added to the blue box?
(list)

APPENDIX G

SUPPORT DOCUMENTATION FOR DEMONSTRATION PROJECT PILOT STUDIES

- G.1 Statistical Analysis**
- G.2 Capture Rate Analysis**
- G.3 Conveyor Belt Sorting Analysis**

SUPPORT DOCUMENTATION FOR DEMONSTRATION PROJECT PILOT STUDIES

G.1 Stastical Analysis

G.1.1 Linear Regression Analysis

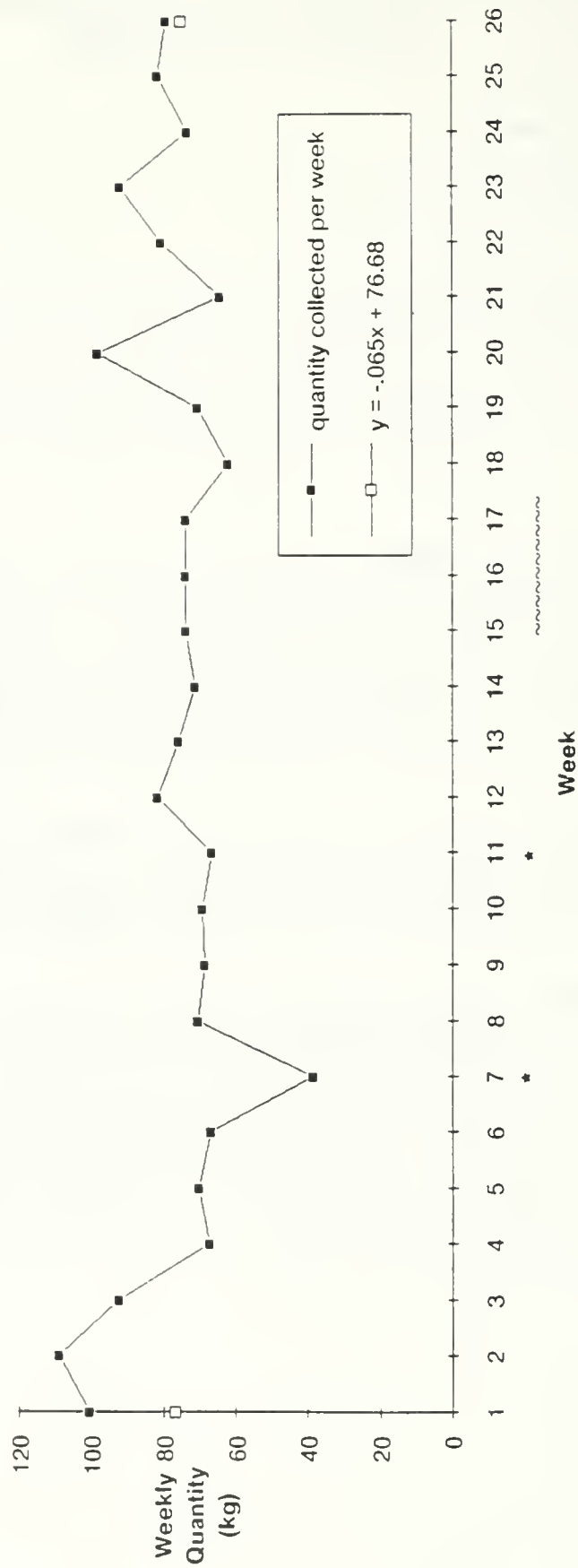
A simple linear regression analysis was performed on the data from Test Areas A and B. To perform the multi-dimensional analysis, the total quantity of plastic collected each week was assigned the y coordinate and week of collection was designated as the x coordinate. The results of the analysis are illustrated in Figures G.1 and G.2.

The slope of the lines of best fit for both test areas was negative and near zero, ranging from -0.065 kg/week in the case of Test Area A to -0.66 kg/week in the case of Test Area B. The slopes indicate that the quantity of plastic collected each week marginally declined over the study period; however, the decline was minimal and the quantity of plastic collected each week was relatively independent of time.

Upon observation, the lines of best fit appear to adequately fit the data, however large fluctuations in weekly quantities were observed and are largely attributable to disruptions in collection that were encountered throughout the study.

The study team attempted to calculate the sample correlation coefficient, for each Test Area, however, the coefficient is extremely unstable as the coefficient tends to infinity as the slope of the line approaches zero. The sample correlation coefficient is a measure of the degree of the linear relationship between variables. Generally, a strong linear correlation is said to exist if the absolute value of the correlation coefficient lies between 0.8 and 1, while poor correlation exists if the absolute value of the coefficient lies between 0 and 0.5.

Figure G.1
Test Area A - Weekly Quantity Collected



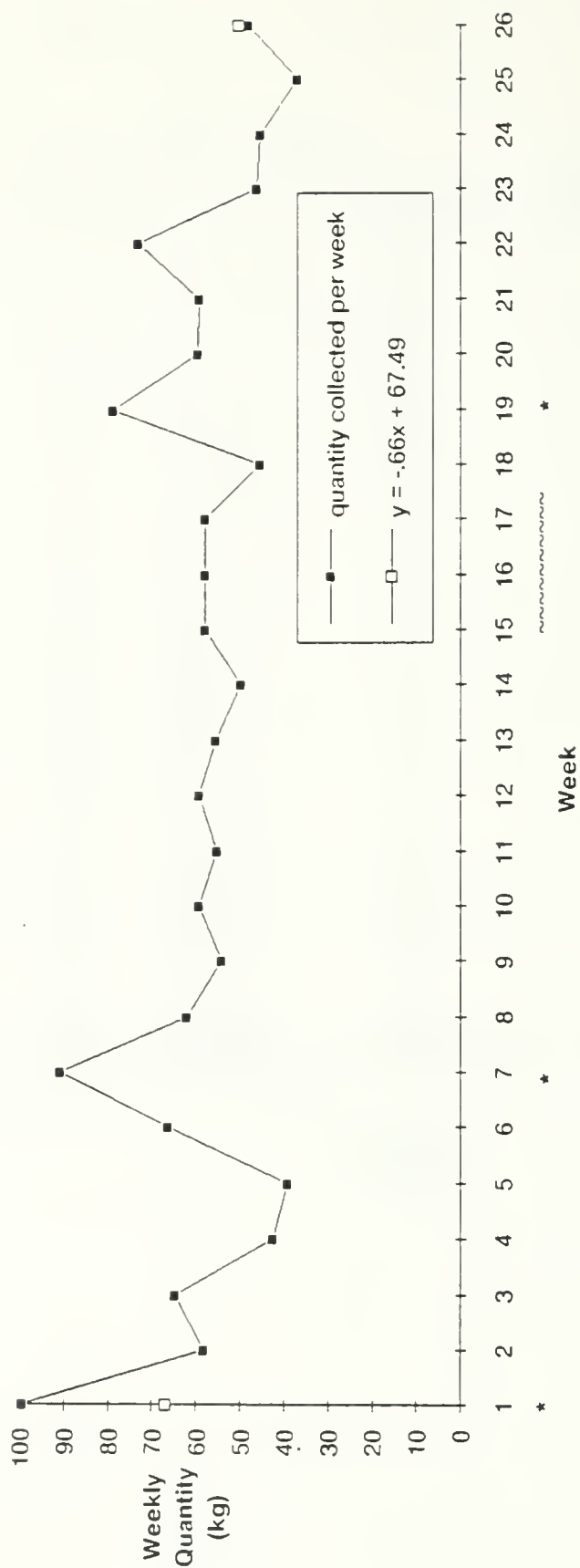
* - disruptions in collection
 ~~~ - no collection (quantities estimated)

Table G.1  
Linear Regression Analysis - Test Area A

| x (week) | y (kg/week) | x * y   | x * x | y * y       |
|----------|-------------|---------|-------|-------------|
| 1        | 100.51      | 100.51  | 1     | 10102.2601  |
| 2        | 109.05      | 218.1   | 4     | 11891.9025  |
| 3        | 92.38       | 277.14  | 9     | 8534.0644   |
| 4        | 67.08       | 268.32  | 16    | 4499.7264   |
| 5        | 70.12       | 350.6   | 25    | 4916.8144   |
| 6        | 66.96       | 401.76  | 36    | 4483.6416   |
| 7        | 38.46       | 269.22  | 49    | 1479.1716   |
| 8        | 70.47       | 563.76  | 64    | 4966.0209   |
| 9        | 68.44       | 615.96  | 81    | 4684.0336   |
| 10       | 69.24       | 692.4   | 100   | 4794.1776   |
| 11       | 66.52       | 731.72  | 121   | 4424.9104   |
| 12       | 81.56       | 978.72  | 144   | 6652.0336   |
| 13       | 75.84       | 985.92  | 169   | 5751.7056   |
| 14       | 71.2        | 996.8   | 196   | 5069.44     |
| 15       | 73.73       | 1105.95 | 225   | 5436.1129   |
| 16       | 73.73       | 1179.68 | 256   | 5436.1129   |
| 17       | 73.73       | 1253.41 | 289   | 5436.1129   |
| 18       | 61.87       | 1113.66 | 324   | 3827.8969   |
| 19       | 70.33       | 1336.27 | 361   | 4946.3089   |
| 20       | 98.3        | 1966    | 400   | 9662.89     |
| 21       | 64.22       | 1348.62 | 441   | 4124.2084   |
| 22       | 80.68       | 1774.96 | 484   | 6509.2624   |
| 23       | 92.04       | 2116.92 | 529   | 8471.3616   |
| 24       | 73.37       | 1760.88 | 576   | 5383.1569   |
| 25       | 81.6        | 2040    | 625   | 6658.56     |
| 26       | 79.37       | 2063.62 | 676   | 6299.5969   |
| 351      | 1970.8      | 26510.9 | 6201  | 154441.4834 |

R = -0.034903134  
m = -0.064888889  
b = 76.676

Figure G.2  
Test Area B - Weekly Quantity Collected



\* - includes some material from previous week

~~~~~ - no collection (quantity estimated)

Table G.2
Linear Regression Analysis - Test Area B

| x (week) | y (kg/week) | x * y | x * x | y * y |
|----------|-------------|----------|-------|------------|
| 1 | 99.37 | 99.37 | 1 | 9874.3969 |
| 2 | 58.18 | 116.36 | 4 | 3384.9124 |
| 3 | 64.81 | 194.43 | 9 | 4200.3361 |
| 4 | 42.45 | 169.8 | 16 | 1802.0025 |
| 5 | 39.06 | 195.3 | 25 | 1525.6836 |
| 6 | 66.44 | 398.64 | 36 | 4414.2736 |
| 7 | 90.7 | 634.9 | 49 | 8226.49 |
| 8 | 61.92 | 495.36 | 64 | 3834.0864 |
| 9 | 54.22 | 487.98 | 81 | 2939.8084 |
| 10 | 59.17 | 591.7 | 100 | 3501.0889 |
| 11 | 55.19 | 607.09 | 121 | 3045.9361 |
| 12 | 59.15 | 709.8 | 144 | 3498.7225 |
| 13 | 55.54 | 722.02 | 169 | 3084.6916 |
| 14 | 49.79 | 697.06 | 196 | 2479.0441 |
| 15 | 57.83 | 867.45 | 225 | 3344.3089 |
| 16 | 57.83 | 925.28 | 256 | 3344.3089 |
| 17 | 57.83 | 983.11 | 289 | 3344.3089 |
| 18 | 45.38 | 816.84 | 324 | 2059.3444 |
| 19 | 78.93 | 1499.67 | 361 | 6229.9449 |
| 20 | 59.6 | 1192 | 400 | 3552.16 |
| 21 | 59.13 | 1241.73 | 441 | 3496.3569 |
| 22 | 73.07 | 1607.54 | 484 | 5339.2249 |
| 23 | 46.35 | 1066.05 | 529 | 2148.3225 |
| 24 | 45.38 | 1089.12 | 576 | 2059.3444 |
| 25 | 37 | 925 | 625 | 1369 |
| 26 | 48.22 | 1253.72 | 676 | 2325.1684 |
| 351 | 1522.54 | 19587.32 | 6201 | 94423.2662 |

R = -0.348487099

m = -0.661176068

b = 67.48510769

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G.1.2 Hypothesis Testing

A simple statistical test was performed on the data collected during this study. The test, which is referred to as hypothesis testing, is used to test various hypotheses about the means or variances of two populations. In this case, the average quantity of film collected per household from each test area was assumed to be identical (null hypothesis). This hypothesis was then tested at several levels of significance (maximum type I error probability) and was either accepted or rejected. The results of the test are summarized as follows:

| <u>Test Area A</u> | | | <u>Test Area B</u> | | |
|-----------------------|---|---|--|---|------|
| mean | = | 48.0 | mean | = | 42.5 |
| population deviation | = | 8.9 | population deviation | = | 10.3 |
| number of samples | = | 26 | number of samples | = | 26 |
| Test Statistic | = | $(48.0 - 42.5)/\text{SQRT}((8.9)^2/26 + (10.3)^2/26)$ | | | |
| | = | 2.1 | | | |
| Level of Significance | | | Rejection Region
(one-tailed test area) | | |
| 1% | | | $Z \geq 2.3$ accepted | | |
| 2% | | | $Z \geq 2.1$ rejected | | |
| 3% | | | $Z \geq 1.9$ rejected | | |

The test indicated that the null hypothesis is rejected when the level of significance, (or the probability of rejecting the null hypothesis when it is true) is less than 2%. Because the level of significance at which the null hypothesis is rejected is low, this infers that the null hypothesis is not correct and the mean value for Test Area B is in fact lower than the mean value for Test Area A. Expressed in another way, the difference in mean values between Test Areas A and B is large enough to suggest that the actual values are different.

G.2 Capture Rate Analysis

Test Area A:

Number of households = 1,578

Total quantity of plastic film collected per year = 3,724 kg/year

Type I households = 723

Type II households = 406

Estimated quantity previously present as ONP packaging (15%)

= 559 kg/year

= 0.495 kg/participant

Type II household quantity captured

= 0.495 kg/Hh

Type I household quantity captured

= (3,724 kg/year - 0.495 kg/Hh x 406 Hh)/723 Hh

= 4.873 kg/Hh

Test Area B:

Number of households = 1,372

Total quantity of plastic film collected per year = 2,895 kg/year

Type I households = 752

Type II households = 225

Estimated quantity previously present as ONP packaging (15%)

= 434 kg/year

= 0.444 kg/participant

Type II household quantity captured

= 0.444 kg/Hh

Type I household quantity captured

= (2,895 kg/year - 0.444 kg/Hh x 225 Hh)/752 Hh

= 3.717 kg/Hh

Capture Rate Calculation:

Test Area A:

$$\begin{aligned}\text{capture rate (Type I participant)} &= \frac{4.873 \text{ kg/Hh}}{13.5 \text{ kg/Hh}} \\ &= 36.1\% \\ \text{capture rate (Type II participant)} &= \frac{0.495 \text{ kg/Hh}}{13.5 \text{ kg/Hh}} \\ &= 3.7\%\end{aligned}$$

Test Area B:

$$\begin{aligned}\text{capture rate (Type I participant)} &= \frac{3.717 \text{ kg/Hh}}{8.4 \text{ kg/Hh}} \\ &= 44.3\% \\ \text{capture rate (Type II participant)} &= \frac{0.444 \text{ kg/Hh}}{8.4 \text{ kg/Hh}} \\ &= 5.3\%\end{aligned}$$

G.3 Conveyor Belt Sorting Analysis

Explanation of Cost Calculations

Summary of Results:

I. Test Area Material

The results of all test runs (21) conducted on Test Area material were compiled. These runs consist predominantly of Test Area B type material, but do include a few Test Area A results from the first set of runs (November, 1990).

Results are expressed in terms of the quantity of ONP and film sorted per minute, as well as the inverse in terms of the time (in minutes) to sort a kilogram of each type of material.

II Base Case Material

The results of the 15 test runs on base case material were included for analysis. Results are expressed in the same terms as the Test Area material.

Calculations

Variables:

1. The labour efficiency is a variable that includes both worker efficiency and operational factors. At 100%, labour efficiency all conditions are at optimum (e.g., burden depth on conveyor belt, belt speed, working conditions, worker sorting efficiency, etc.). These conditions were optimized during the pilot study trial runs. Therefore, in order to allow for conditions which are less than optimum for any of these factors, including downtime, time to load the belt, etc., the municipality can apply a factor which is applicable to their facilities.

2. The cost per employee hour can be adjusted to reflect the cost assumed in each facility.

Manhours per Tonne ONP (base case):

This cost indicates the current time to sort plastic bags from newspaper on a per tonne newspaper basis at 100% efficiency.

Manhours per Tonne ONP (test area):

This cost indicates the estimated time to sort plastic film from newspaper if plastic film were added to the blue box program on a per tonne newspaper basis (at maximum efficiency).

Incremental Manhours Expressed Relative to Incremental Tonne Film:

This time is the incremental increase in the time to sort plastic film from newspaper as compared to the current time, on a per tonne basis of the incremental quantity of plastic film.

Conveyor Belt Sorting Analysis

Summary of Results:

I. Test Area Material (21 runs)

| | | |
|----------------------------|------------------|------------------------|
| Mass material sorted/time: | 16.25 kg ONP/min | [or 0.0615 min/kg ONP] |
| | 0.46 kg film/min | [or 2.15 min/kg film] |

II. Base Case Material (15 runs)

| | | |
|----------------------------|------------------|------------------------|
| Mass material sorted/time: | 30.21 kg ONP/min | [or 0.0332 min/kg ONP] |
| | 0.13 kg film/min | [or 7.51 min/kg film] |

Calculations

I. Incremental time to sort ONP:

$$\begin{aligned} &= \frac{\text{sorting time per kg ONP (test area)} - \text{sorting time per kg ONP (base case)}}{\text{sorting time per kg ONP (base case)}} \\ &= \frac{0.0615 \text{ min/kg ONP (test area)} - 0.0332 \text{ min/kg ONP (base case)}}{0.0332 \text{ min/kg ONP (base case)}} \\ &= 85.43\% \end{aligned}$$

II. Manhour requirements for sorting per tonne material (assuming labour efficiency is 100%):

Manhours per Tonne ONP (base case)

$$\begin{aligned} &= \frac{\text{sorting time per kg ONP (base case)} \times 1000 \text{ kg/tonne}}{60 \text{ min/hr}} \\ &= \frac{0.0322 \text{ min/kg ONP (base case)} \times 1000 \text{ kg/tonne}}{60 \text{ min/hr}} \\ &= 0.55 \text{ manhours/tonne ONP} \end{aligned}$$

Manhours per Tonne ONP (test area)

$$\begin{aligned} &= \frac{\text{sorting time per kg ONP (test area)} \times 1000 \text{ kg/tonne}}{60 \text{ min/hr}} \\ &= \frac{0.0615 \text{ min/kg ONP (test area)} \times 1000 \text{ kg/tonne}}{60 \text{ min/hr}} \\ &= 1.03 \text{ manhours/tonne ONP} \end{aligned}$$

Incremental Manhours Expressed Relative to Incremental Tonne Film

$$\begin{aligned} &= \frac{\text{incremental sorting time per tonne ONP}}{\text{incremental quantity of film sorted per tonne ONP}} \\ &= \frac{0.47 \text{ manhours/tonne ONP}}{.024 \text{ tonne film/tonne ONP}} \\ &= 19.58 \text{ manhours/tonne film} \end{aligned}$$

III. Cost per tonne material:

Variables:

1. labour efficiency (%)
2. cost per employee hour (\$/hr)

Cost per Tonne ONP (base case)

$$\begin{aligned} &= \frac{0.55 \text{ manhours/tonne} \times \text{cost per employee hour (\$/hr)}}{\text{labour efficiency (\%)}} \\ &= \text{_____ \$/tonne ONP} \end{aligned}$$

Cost per Tonne ONP (test area)

$$\begin{aligned} &= \frac{1.03 \text{ manhours/tonne} \times \text{cost per employee hour (\$/hr)}}{\text{labour efficiency (\%)}} \\ &= \text{_____ \$/tonne ONP} \end{aligned}$$

Incremental Cost Expressed Relative to Incremental Tonne Plastic Film

$$\begin{aligned} &= \frac{19.58 \text{ manhours/tonne} \times \text{cost per employee hour (\$/hr)}}{\text{labour efficiency (\%)}} \\ &= \text{_____ \$/tonne plastic film} \end{aligned}$$

Sample Calculation:

Assumptions

1. labour efficiency = 80%
2. cost per employee hour = \$10/hr (fully burdened)

Cost per Tonne ONP (base case)

$$\begin{aligned} &= \frac{0.55 \text{ manhours/tonne} \times \$10/\text{hr}}{80\%} \\ &= \$6.88/\text{tonne ONP} \end{aligned}$$

Cost per Tonne ONP (test area)

$$\begin{aligned} &= \frac{1.03 \text{ manhours/tonne} \times \$10/\text{hr}}{80\%} \\ &= \$12.88/\text{tonne ONP} \end{aligned}$$

Incremental Cost Expressed Relative to Incremental Tonne Plastic Film

$$\begin{aligned} &= \frac{19.58 \text{ manhours/tonne} \times \$10/\text{hr}}{80\%} \\ &= \$244.75/\text{tonne plastic film} \end{aligned}$$

Example:

Apply above costs to a city the size of Peterborough

Current cost of sorting ONP:

quantity collected per year = 2,000 tonnes/year
cost/tonne (base case) = \$6.88/tonne ONP
cost/year = 2,000 tonnes x \$6.88/tonne = \$13,760

Estimated cost of sorting test area material:

quantity collected per year = 2,000 tonnes/year
cost/tonne (base case) = \$12.88/tonne ONP
cost/year = 2,000 tonnes x \$12.88/tonne = \$25,760

Incremental cost of sorting plastic film:

= \$25,760 - \$13,760
= \$12,000

Incremental cost expressed relative to incremental tonne plastic film:

= \$245/tonne plastic film

Incremental cost expressed relative to tonne plastic film (total film quantity including film present previously in base case)

= \$211/tonne plastic film

Estimated cost per household:

= \$12,000/21,000 households
= \$0.57 per household/year

Example: Total Estimated Incremental Processing Costs for Plastic Film at the MRF

Apply costs to Peterborough

Assumptions:

1. Baling Costs:

| | |
|--------------|--|
| ONP | \$20/tonne |
| Plastic Film | \$60/tonne (estimate based on demonstration project experience where plastic film and ONP bale weights were similar but it took three times as long to complete a plastic film bale) |

2. Revenue:

| | |
|--------------|---------------------------------|
| ONP | \$40/tonne |
| Plastic Film | \$100/tonne (industry estimate) |

3. Disposal Costs:

tipping fee at landfill = \$100/tonne

4. Quantities of Material Collected/year:

| | |
|---------------------|----------------|
| ONP | 2000 tonnes/yr |
| Plastic Film (est.) | 56 tonnes/yr |
| Plastic Film (base) | 8.6 tonnes/yr |

Calculations:

1. Test Area:

| | |
|--------------------|--|
| sorting time | = 2000 tonnes/year x .0615 min/kg ONP x 1000 kg/tonne x 1 hr/60min
= 2050 hrs/year |
| cost | = sorting time/efficiency + baling costs
= (2050 hrs/yr x \$10/hr) /80% + (2000 tonnes ONP x \$20/tonne) +
(56 tonnes plastic film x \$60/tonne)
= \$68,985 |
| cost per household | = \$68,985/21,000 Hh
= \$3.29/Hh |
| revenue | = (2000 tonnes ONP x \$40/tonne) + (56 tonnes plastic film x \$100/tonne)
= \$85,600/yr |
| net revenue | = \$16,615/yr |

2. Base Case

| | |
|--------------------|--|
| sorting time | = 2000 tonnes/year x .0332 min/kg ONP x 1000 kg/tonne x 1 hr/60min
= 1107 hrs/year |
| cost | = sorting time/efficiency + baling costs + disposal costs
= (1107 hrs/yr x \$10/hr) /80% + (2000 tonnes ONP x \$20/tonne) +
(8.6 tonnes plastic film x \$100/yr)
= \$54,698 |
| cost per household | = \$54,698/21,000 Hh
= \$2.60/Hh |
| revenue | = (2000 tonnes ONP x \$40/tonne)
= \$80,000/yr |
| net revenue | = \$25,302/yr |

3. Incremental Costs

incremental cost of processing film = \$8,687/yr

incremental cost per household = \$0.41/Hh/yr

Table G.3
Conveyor Belt Sorting Analysis

Date: November 1990, March, 1991
Material Type: Test Area A & B
Belt Speed: - controlled speed to maximize sorting

| Trial Number | Sorting Time (s) * | ONP Mass (kg) | FPF Mass (kg) | Mass Material Sorted per Sorter per Time | | Sorting Time per Material Type | |
|--------------|--------------------|---------------|---------------|--|--------------|--------------------------------|--------------|
| | | | | ONP (kg/min) | FPF (kg/min) | ONP (min/kg) | FPF (min/kg) |
| Mar 8/91 | | | | | | | |
| 1 | 1106 | 257 | 20.24 | 13.94 | 1.10 | 0.07 | 0.91 |
| 2 | 1440 | 262 | 7.79 | 10.92 | 0.32 | 0.09 | 3.08 |
| 3 | 1270 | 274 | 11.23 | 12.94 | 0.53 | 0.08 | 1.88 |
| 4 | 1350 | 300 | 6.70 | 13.33 | 0.30 | 0.08 | 3.36 |
| 5 | 1894 | 380 | 17.71 | 12.04 | 0.56 | 0.08 | 1.78 |
| Mar 13/91 | | | | | | | |
| 1 | 1566 | 395 | 23.00 | 15.13 | 0.88 | 0.07 | 1.13 |
| 2 | 1490 | 487 | 9.73 | 19.61 | 0.39 | 0.05 | 2.55 |
| 3 | 878 | 318 | 5.84 | 21.73 | 0.40 | 0.05 | 2.51 |
| 4 | 1321 | 361 | 12.45 | 16.40 | 0.57 | 0.06 | 1.77 |
| 5 | 1489 | 407 | 12.58 | 16.40 | 0.51 | 0.06 | 1.97 |
| 6 | 1374 | 442 | 11.99 | 19.30 | 0.52 | 0.05 | 1.91 |
| Nov 21/91 | | | | | | | |
| 1 | 2324 | 535 | 15.56 | 13.81 | 0.40 | 0.07 | 2.49 |
| 2 | 1888 | 465 | 10.60 | 14.78 | 0.34 | 0.07 | 2.97 |
| 3 | 2180 | 544 | 17.02 | 14.97 | 0.47 | 0.07 | 2.13 |
| 4 | 1372 | 285 | 5.46 | 12.46 | 0.24 | 0.08 | 4.19 |
| Nov 30/91 | | | | | | | |
| 1 | 1374 | 475 | 12.30 | 20.74 | 0.54 | 0.05 | 1.86 |
| 2 | 1142 | 369 | 4.06 | 19.39 | 0.21 | 0.05 | 4.69 |
| 3 | 1410 | 466 | 5.28 | 19.83 | 0.22 | 0.05 | 4.45 |
| 4 | 1166 | 365 | 10.50 | 18.78 | 0.54 | 0.05 | 1.85 |
| 5 | 1204 | 414 | 9.92 | 20.63 | 0.49 | 0.05 | 2.02 |
| 6 | 1246 | 456 | 6.16 | 21.96 | 0.30 | 0.05 | 3.37 |
| TOTAL | 30,484 | 8,257 | 236,127 | 349.11 | 9.83 | 1.32 | 52.89 |

* Sort time equals total time x 2 to account for 2 sorters

| Sample Calculations (ONP kg/min): | | | |
|-----------------------------------|--------|--------|--------|
| No. of Samples | 21 | 21 | 21 |
| Arithmetic Average | 16.62 | 0.47 | 0.06 |
| Weighted Average | 16.25 | 0.46 | 0.06 |
| Sample Std. Deviation | 3.50 | 0.21 | 0.01 |
| Coefficient of Variation | 21.06% | 45.13% | 21.81% |
| | | | 40.81% |

Arithmetic Average = $349.11/21 = 16.62$
 Weighted Average = $8,257/30,484 * 60 = 16.25$
 Coefficient of Variation = $3.50/16.62 * 100\% = 21.06\%$
 Proctor & Redfern Limited

Table G.4
Conveyor Belt Sorting Analysis

Date: Friday, March 8 and Wednesday, March 13, 1991
Material Type: Base case load
Belt Speed: - controlled speed to maximize sorting

| Trial Number | Sorting Time (s) ** | ONP Mass (kg) | FPF Mass (kg) | Mass Material Sorted per Time | | Sorting Time per Material Type | |
|--------------|---------------------|---------------|---------------|-------------------------------|--------------|--------------------------------|--------------|
| | | | | ONP (kg/min) | FPF (kg/min) | ONP (min/kg) | FPF (min/kg) |
| Mar 8/91 | 1 | 281 | 1.96 | 28.87 | 0.20 | 0.03 | 4.97 |
| | 2 | 279 | 1.01 | 39.11 | 0.14 | 0.03 | 7.06 |
| | 3 | 313 | 1.69 | 47.66 | 0.26 | 0.02 | 3.89 |
| | 4 | 293 | 1.02 | 42.88 | 0.15 | 0.02 | 6.70 |
| | 5 | 310 | 1.81 | 32.01 | 0.19 | 0.03 | 5.35 |
| | 6 | 406 | 1.18 | 37.30 | 0.11 | 0.03 | 9.22 |
| | 7 | 262 | 1.08 | 30.88 | 0.13 | 0.03 | 7.85 |
| | 8 | 274 | 1.79 | 28.10 | 0.18 | 0.04 | 5.44 |
| | 9 | 275 | 1.10 | 34.45 | 0.14 | 0.03 | 7.24 |
| | 10 | 242 | 1.23 | 26.79 | 0.14 | 0.04 | 7.36 |
| Mar 13/91 | 1 | 366 | 1.30 | 27.08 | 0.10 | 0.04 | 10.40 |
| | 2 | 395 | 1.51 | 28.08 | 0.11 | 0.04 | 9.32 |
| | 3 | 341 | 1.29 | 24.50 | 0.09 | 0.04 | 10.79 |
| | 4 | 397 | 1.31 | 28.63 | 0.09 | 0.03 | 10.59 |
| | 5 | 361 | 1.86 | 20.91 | 0.11 | 0.05 | 9.28 |
| TOTAL | 9523 | 4795 | 21.141 | 477.27 | 2.13 | 0.49 | 115.46 |

** equals actual sorting time since only 1 sorter

| No. of Samples | | 15 | 15 | 15 | 15 |
|--------------------------|--|--------|--------|--------|--------|
| Arithmetic Average | | 31.82 | 0.14 | 0.03 | 7.70 |
| Weighted Average | | 30.21 | 0.13 | 0.03 | 7.51 |
| Sample Std. Deviation | | 7.23 | 0.05 | 0.01 | 2.19 |
| Coefficient of Variation | | 22.72% | 33.27% | 21.30% | 28.41% |

APPENDIX H

OVERVIEW OF PLASTIC GROCERY SACK RECOVERY AND RECYCLING

OVERVIEW OF PLASTIC GROCERY SACK RECOVERY AND RECYCLING

Plastic grocery sack (PGS) recovery (store depots and limited curbside) has experienced a substantial growth during the past year and by the end of 1990 an estimated 10,000(+) supermarkets were participating in PGS recycling programs in Canada and the U.S. Interest in PGS recycling has increased to the point that a few of blue box programs in Atlantic Canada now collect, sort and sell to PGS manufacturers. PGS are also collected at the curb as part of mixed plastics blue box collection in Ontario.

Currently four manufacturers produce most of the PGSs used in North America.

- | | | |
|---|------------------------------|----------------------------|
| ■ | Sonoco Products Company Inc. | Hartsville, South Carolina |
| ■ | Mobil Chemical Company | Pittsford, New York |
| ■ | Vanguard Plastics Inc. | St. Louis, Missouri |
| ■ | PCL Group | Oakville, Ontario |
| | | Saint John, New Brunswick |

Each of these companies helped to establish collection programs by providing retailers with collection depots, promotional material and a market for the PGSs (Table H.1). PCL & Eastern of Saint John, New Brunswick has also encouraged the collection of PGSs in local curbside and depot programs, and now purchases baled PGSs from curbside programs in Fredricton and Woodstock (New Brunswick) and Kings County (Nova Scotia).

PCL Group

The PCL Group is involved in PGS recycling through PCL Packaging Ltd of Oakville Ontario and PCL & Eastern of St. John, New Brunswick. Each company operates independent programs for the collection of PGSs from retail customers of their products.

PCL & Eastern began its collection program in the summer of 1989 and has collected over 500 tonnes of PGS from 347 supermarkets in Atlantic Canada, the New England States and 3 blue box programs in Nova Scotia and New Brunswick.

Table H.1

Summary of Plastic Grocery Sack
Collection Programs In North America

| Collection Program | Participating
Stores | Participating
Curbside
Programs | Percentage of
Bags Returned | Percentage of Film Collected | | Final
Product |
|--------------------|-------------------------|---------------------------------------|--------------------------------|------------------------------|------|-----------------------|
| | | | | HDPE | LDPE | |
| Sonoco Products | 6,732 | N/A | 8% - 12% | 60% | 40% | Bottles, edgeboard |
| Mobil Chemical | 2,321 | N/A | 20% | N/A | N/A | Industrial trash bags |
| Vanguard Plastics | 2,000 - 2,500 | N/A | 20% - 25% | N/A | N/A | Grocery bags |
| PCL Packaging (a) | 1,000 | N/A | 15% - 20% | 5% | 95% | Grocery bags |
| PCL & Eastern (b) | 347 | 3 | 20% | 5% | 95% | Grocery bags |

N/A - Not Available

Sources: Amidon, 1990

(a) (Rourke, pers. comm., 1990)

(b) (Millar, pers. comm., 1990)

PCL & Eastern has been working in conjunction with a number of supermarket chains including Hannaford Brothers, IGA, Coop, Atlantic wholesalers and a series of independent stores. Each retailer is provided with a labeled collection bin to be located inside the store for PGSs only. The store depot system has recovered an estimated 18% of the PGSs sold at supermarkets serviced by PCL & Eastern.

Collection of PGSs from supermarket depots is provided by either the local blue box program or by PCL & Eastern in areas with no blue box collection. Although blue box collection of PGSs does not provide a large percentage of the material collected by PCL & Eastern, it does provide the highest quality material and is the preferred method of collection. Three blue box programs currently supply PCL & Eastern:

- | | | |
|---|---------------------------|---------------------------|
| ■ | Kings County Recyclers | Kings County, Nova Scotia |
| ■ | Carleton County Recyclers | Woodstock, New Brunswick |
| ■ | City of Fredricton | Fredricton, New Brunswick |

PCL & Eastern provides posters in supermarkets, advertisements in local newspapers and bag stuffers for PGSs. This promotion encourages residents to turn bags inside out and remove paper, food or any other materials before placing them at curbside or in the supermarket collection bin. This method has resulted in very low contamination levels (less than 5%). It is estimated by PCL & Eastern that the blue box programs yield approximately 1.2 kg/household/year of PGSs with an average participation rate between 60% and 70% for each program (Millar, pers. comm., 1990).

Each program has a different method of operation which is due to the different percentages of rural and urban households served. For example, the City of Fredricton has been collecting PGSs comingled with aluminum cans from approximately 13,000 urban households since 1989 (pers. comm., Bayley, 1990). Kings County collects from approximately 10,700 households in 3 communities (Wolfville, Kentville, Berwick) and separates the PGSs into a collection box which is welded under the collection vehicle (pers. comm., Van Rooyen, 1990). Carleton County is predominately rural and utilizes both a recycling depot to collect from approximately 3,500 households as well as from 1,250 blue boxes (pers. comm., Peabody, 1990). All PGSs are brought to a centralized storage facility where they

accumulate until a sufficient amount is available to be baled. The bales are shipped to PCL & Eastern in St John where they are hand sorted and processed into new PGSs. PCL & Eastern estimates that its bags contain 24% post consumer material and that this could be increased to 40% post consumer carton; if there was a sufficient supply.

PCL Packaging in Ontario operates a store depot collection program. Currently PCL Packaging collects from over 1,000 A&P and Food City stores in southern Ontario. PCL Packaging provides supermarkets with a labeled collection bin which is to be located inside the store. An estimated 15% to 20% of the PGSs sold on a store by store basis are recovered. Similar to PCL & Eastern, the PGSs collected are predominantly low density polyethylene (approximately 95%) and are shipped to a centralized location where they are baled before being collected by PCL Packaging (pers. comm., Rourke, 1990).

Mobil Chemical Company

Mobil began its collection of PGSs from Wegman Stores in February 1990. This program has continued to expand and currently includes 2,000 stores nationwide. Each supermarket is provided with a collection bin for PGSs only. The PGSs collected by the Mobil program are predominantly high density polyethylene, however a small quantity of low density polyethylene is also collected. Both are processed into industrial garbage bags. It is estimated that 20% of the PGSs sold by Mobil are collected through this program.

Each supermarket is responsible for collecting and shipping the PGS to a centralized location (usually the store's warehouse) where it is baled and later collected by Mobil for processing (Amidon, 1990).

Sonoco Products Company

Sonoco Products began its collection of PGS in March of 1990 and has expanded to over 6,700 locations across the U.S. Three types of collection bins are used in the Sonoco program:

- cardboard boxes
- recycled fiber drums
- plastic containers

Each container is fitted with a removable polyethylene liner and labeled as a collection bin for PGS only. Sonoco estimates that it collects 8% to 12% of the high density polyethylene grocery sacks it sells.

Similar to other collection programs, the PGSs collected are sent to a centralized location where they are baled and later collected by Sonoco Products for processing into plastic bottles. Although Sonoco produces PGSs made from high density polyethylene an estimated 40% of the collected material is low density polyethylene (Amidon, 1990).

Vanguard Plastics Inc.

Vanguard Plastics began its collection program in October 1989 and currently collects PGSs from 2,000 - 2,500 stores across U.S. Each participating store is provided with either a fiber collection drum or plywood box. These collection containers are located within the store and labeled for PGS recycling only. Vanguard estimates it recovers 20% to 25% of the high density polyethylene PGSs it sells.

Collected PGSs are shipped to a centralized location (usually the store's warehouse) where they are baled and later collected by Vanguard for processing into PGSs. The Vanguard process allows for up to 10% post consumer plastic film in its feedstock (Amidon, 1990).

Program Operation

Industry sources estimate that a successfully run PGS collection program could capture approximately 10% to 30% of the PGSs which are sold through a store depot program. To achieve these results, it is expected that the following program elements would be required:

- a comprehensive promotional and education program to inform consumers which bags are acceptable,
- how the bags are to be recycled (turning the bag inside out to remove contaminants), and
- where to deposit them (blue box or store depot).

Experience from a number of store depot collection programs suggests that information can effectively conveyed through the use of bag stuffers, newspaper advertisements, store displays and printing instructions on the bag (Millar, 1990).

Most manufacturers are technically capable on adding up to 50% post consumer and post industrial scrap to their product mix, but is essential that the they have a dependable and clean supply of material. The ratio of post consumer to post industrial cannot be confirmed. It is necessary to educate the public about how and what to recover because uneducated consumers tend to deposit any, whether it is compatible with a particular program or not. Manufacturers suggest that collecting and sorting PGSs through curbside programs would help reduce the level of contamination and increase the demand for post consumer scrap. This is especially true if the price of post consumer scrap is substantially lower turn the virgin scrap it replaces. The larger the price differential the more valuable a dependable and clean supply of post consumer PGS scrap is to a manufacturer. Therefore it is essential to develop collection and sorting systems that keep the cost of processing down so that end markets can be secured (Amidon, 1990).

